Saskatchewan
Environment and
Public Safety

Great Sand Hills

LAND USE STRATEGY

MAY

1991

Great Sand Hills Land Use Strategy

Saskatchewan Environment and Public Safety
May 1991

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1. Introduction

The Great Sand Hills area, a unique and sensitive region of southwestern Saskatchewan, consists of two large blocks located between the Trans-Canada Highway and the South Saskatchewan River (see Map 1). This area has more or less continuous surface deposits of unconsolidated sands. Climatic and soil conditions have combined to create many interesting landforms. In fact, the Great Sand Hills area contains the greatest concentration of dunes in populated areas of Canada. The Great Sand Hills also contain the largest contiguous area of dunes in the Canadian prairie. Large, active sand dunes are one of the most spectacular land features of the Great Sand Hills but only represent about 0.5% of the 1,911 km^2 area.

The Great Sand Hills area is rich in flora and fauna including endangered and rare species, and species unique to sand hills ecosystems. Hunting is very popular in this area as it supports large ungulate and game bird populations.

The major land uses in the Great Sand Hills are agricultural (primarily domestic grazing), gas exploration and development and recreation (hunting, hiking, bird-watching, etc.) Major utility and gas and oil transmission lines also cross the Great Sand Hills.

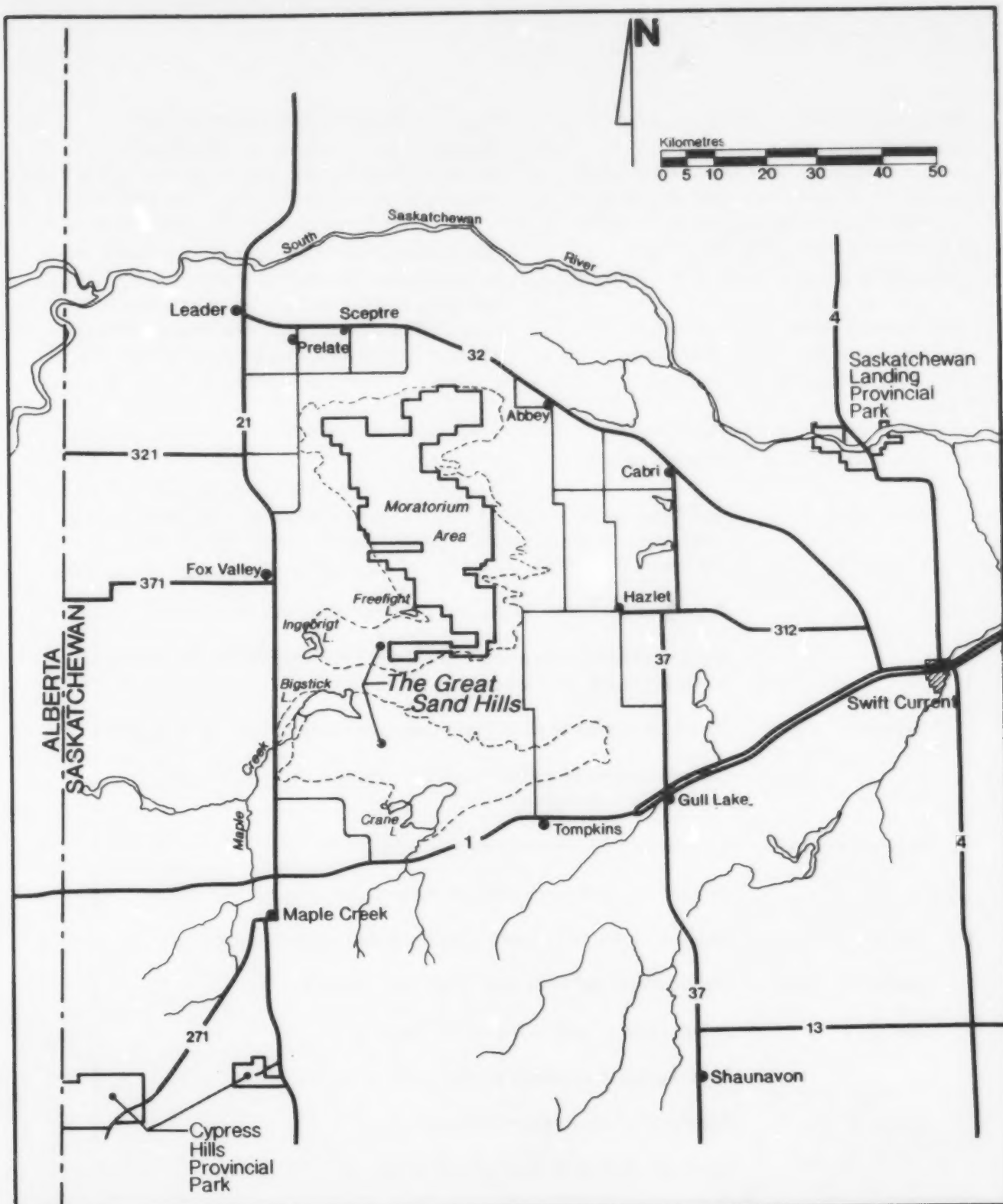
The majority of the Great Sand Hills area is Crown land, much of which is under grazing and mineral leases. Approximately 16% of the area is privately owned.

None of the Great Sand Hills are represented in the parks system; no form of Provincial protected land designation is applied to land in the Great Sand Hills other than portions of land which are designated under *The Critical Wildlife Habitat Protection Act*.

1.1 Planning Process and Study Area

In July, 1990, the Minister of Environment and Public Safety announced the establishment of a planning committee to prepare an integrated land use strategy for the Great Sand Hills. The steps in the planning process are provided in Figure 1.

The Planning Committee consisted of representatives from the Departments of Environment and Public Safety, Energy and Mines, Parks and Renewable Resources and Rural Development. A Planning Coordinator from the consulting firm of UMA Engineering was responsible for facilitating public involvement and presenting the findings of the Planning Committee to the Minister of Environment and Public Safety. Appendix B lists the Planning Committee members.



GREAT SAND HILLS

Integrated Land Use Plan

Saskatchewan Environment and Public Safety

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REGIONAL CONTEXT 1

While the study was taking place, a moratorium was placed on new developments within the most sensitive area of the Great Sand Hills (see Map 1). The immediate effect of the moratorium was to temporarily halt oil and gas exploration and any other new land uses.

The primary focus of this land use strategy is on the moratorium area. However, recommendations and guidelines contained in this strategy should be applied to the entire Great Sand Hills area unless otherwise specified.

The Great Sand Hills Land Use Strategy is intended to be used by government, industry and the public. It applies only to land and resources vested in the Crown in the Great Sand Hills area.

FIGURE 1 The Planning Process

July, 1990	The Minister of the Environment and Public Safety placed a temporary moratorium on new development in a portion of the Great Sand Hills
	An interdepartmental Planning Committee was Established
	An independent Planning Coordinator was employed to facilitate public participation
September, 1990	The first round of public meetings was held
	Collection and analysis of information for the preparation of draft land use plan
November, 1990	Release of public meetings transcripts
	Release of public meetings summary document
January, 1991	Release of draft land use plan for public consultation
February, 1991	Public meetings to review draft land use plan
March, 1991	Integration of public input into final plan
	Final land use strategy presented to Cabinet
April, 1991	Approval of strategy by Cabinet
	Implementation of land use strategy

1.2 Land Management Goal and Objectives

The following goal and objectives are provided to guide development and use of the Great Sand Hills. No priority is implied by order of the objectives.

Goal: To maintain the Great Sand Hills as a distinctive landscape for social, cultural and economic benefits.

Objectives:

To maintain biological diversity and the processes necessary to sustain them.

To protect both representative and unique landscapes.

To ensure sustainable use of renewable resources.

To ensure that development of non-renewable resources occurs in an environmentally sound manner.

To protect heritage resources and support heritage awareness and understanding.

2. Description of the Resources of the Great Sand Hills

2.1 Climate

The climate of the Great Sand Hills is described as a cold, semi-arid steppe climate. "Some years are moister with the cold sub-humid climate from further north shifting into this region, while in other years, the cold, semi-arid climate prevails" (Epp and Townley-Smith 1980:20).

Monthly mean temperatures range from approximately -14 degrees Celsius in January to approximately 19 degrees Celsius in July. Recorded temperature extremes are -42.8 degrees Celsius which occurred in January and 40 degrees Celsius which occurred in July (Environment Canada Atmospheric Services).

The Great Sand Hills region receives on average 316 mm of precipitation annually; 245 mm of rain, and 71.4 mm of snow (Environment Canada Atmospheric Services).

The prevailing winds are from the northwest with a mean annual wind speed of 24 km/h. Monthly mean wind speeds range from 20.5 km/h in July to 26.4 km/h in January. The strongest recorded wind gust was 140 km/h and the maximum recorded hourly wind speed was 112 km/h (Environment Canada Atmospheric Services).

Wind has a major effect on evaporation rates and significantly affects landform features. "The dominant orientations of parabolic dunes, linear streets between dune clusters, and dune tongues all trend largely east-west, indicating prevailing westerly winds" (Mollard et al. 1990). High groundwater tables in deep depressions between dunes, suggest that there is little external runoff out of the dune area and that rain and snowmelt quickly infiltrates to the water table, causing it to rise and stabilize vegetation (Mollard et al. 1990:12).

The western sections of the Great Sand Hills tend to be more susceptible to destabilization from prevailing westerly winds. This is indicated by large blowouts and large bare sand patches. Drought conditions also influence dune stability. However, David (1972) believes that 20 to 30 years of drought are necessary to produce climate-induced, large-scale dune activity.

Climatic conditions have been important factors in producing the physical features of the Great Sand Hills and in determining the biological resources that exist there. Climate is also a major land use factor. Based on historical evidence, climate induced changes in the Great Sand Hills are possible, but change will likely occur very slowly.

2.2 Landforms

The Great Sand Hills are located within the physiographic region known as the third prairie level, Alberta High Plains (Hart and Hunt, 1980) or Alberta Plateau Region (Richards 1969:41). In Saskatchewan, the third prairie level comprises all lands west of the Missouri Coteau to the western boundary of the province.

Regionally, the Great Sand Hills are part of a larger natural region known as the Bigstick Lake Plain (Barclay and Weichel 1979) which lies between the South Saskatchewan River to the north and the Cypress Hills upland to the south. This region consists of glacio-fluvial, glacio-lacustrine and morainal deposits of undulating to rolling topography. In several areas the glacio-fluvial deposits including outwash and delta plains have been reworked by wind action to form sand dunes and interesting dune complexes.

The Great Sand Hills area is the largest of the sand dune complexes within the region. It is dominated by aeolian landforms where sand deposits were laid down by glacial meltwaters and subsequently modified and reworked by wind. The Great Sand Hills thus comprise stabilized dunes and active sand dunes of varying shape and height interspersed with areas of sand flats.

The Great Sand Hills name can be misleading by conjuring an image of great relief and topography. The entire north section lies almost entirely between 708.8 metres (2325 feet) and 747.0 metres (2450 feet) above sea level (a.s.l.), a vertical difference of 38.2 metres (125 feet). Few individual dunes rise more than 15 metres (49.2 feet) above the surrounding plain. The 'ruggedness' of the topography is the result of steeply sloping dunes located close together.

Factors of relief, frequency or density of dunes, slope steepness and the presence of active or stabilized dunes were used to create a detailed classification of landforms by Epp and Townley-Smith (1980). Eight distinctive landforms were identified within the north section of the Great Sand Hills which is the main focus of this land use study. These are listed below.

1. sand flat: level topography, very low frequency of dunes, very low dunes under 2 m, no active sand, 3.6% of the north section;

2. low stabilized dunes: local steep slopes, high frequency of dunes, low dunes under 3 m, no moving sand, 7.8% of the north section;

3. high stabilized dunes: local steep slopes, high frequency of dunes, dunes over 3m, no moving sand, 57.6% of the north section;

4. sand flat-low stabilized dunes: local steep slopes, intermediate frequency of dunes, low dunes under 3 m, no moving sand, 14.9% of the north section;

5. sand flat-high stabilized dunes: local steep slopes, intermediate frequency of dunes, high dunes over 3 m, no moving sand, 5.5% of the north section;

6. low-high stabilized dunes: local steep slopes, high frequency of dunes, variable dune height, no moving sand, 9.8% of the north section;

7. active complexes: local steep slopes, variable dune frequency, variable dune height, moving sand, 0.5% of the north section;

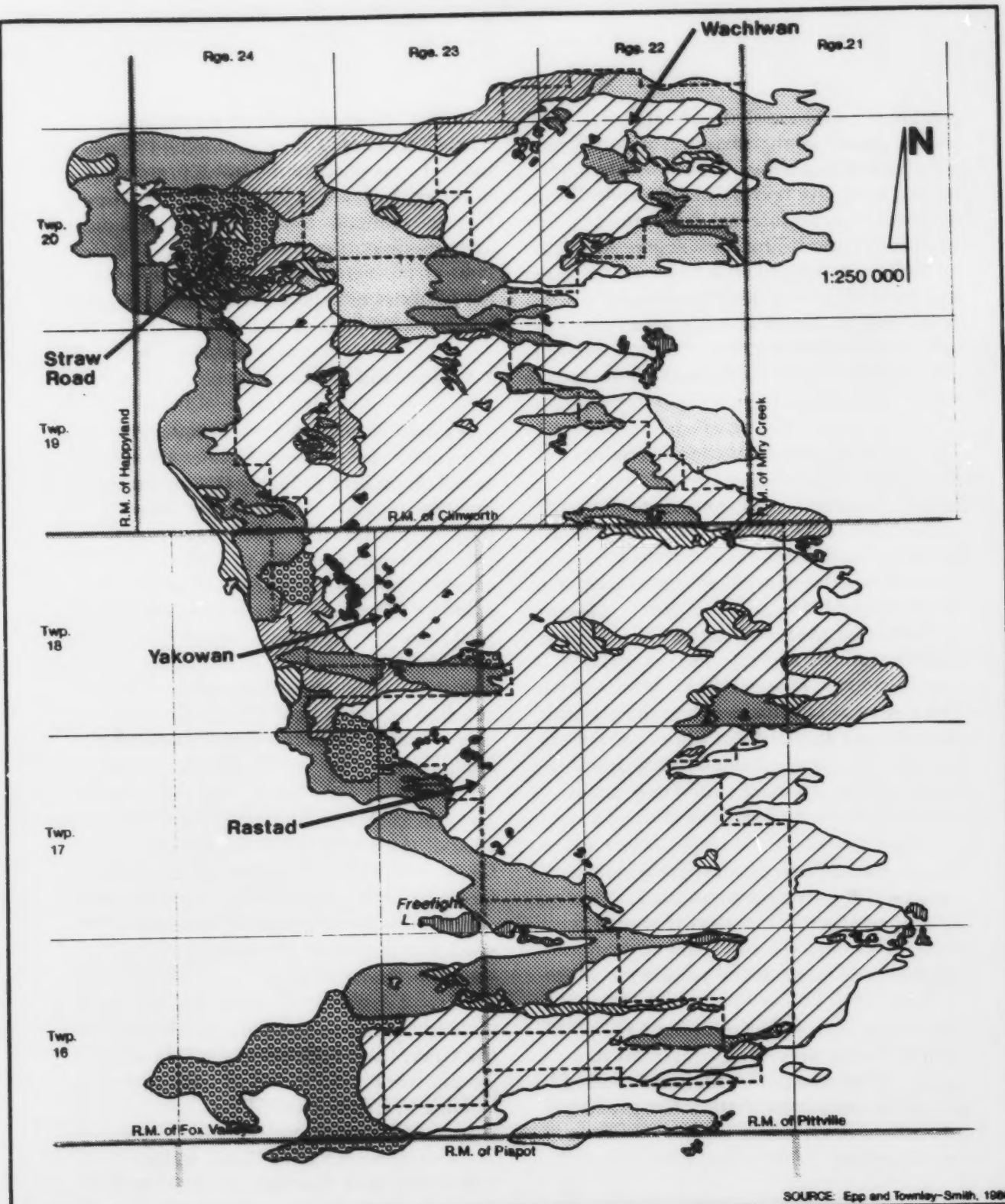
8. intermittent lake beds: flat, no moving sand, 0.2% of the north section;

The distribution of landforms is shown in Map 2. Much of the central part of the Great Sand Hills and over half of the total area is formed of the high stabilized dunes landform. In this landform, dunes are over 3 m (9.8 feet) in height and variations are dependent on the extent of level ground between individual dunes and the amount of relief of the dunes.

Active dunes comprise a very small percentage of the total area although they provide the popular image of the hills. The active dunes occur in four distinct clusters in the Straw Road, Yakowan, Rastad and Wachiwan areas (see Map 2). These tend to be the highest relief areas within the Hills. The combination of high relief and active dunes creates the most spectacular of the landscape features of the Hills.

A variety of dune types have been identified within the Great Sand Hills area. The most significant work on classifying the various types has been done by Dr. Peter David of the University of Montreal and by Dr. Jack Mollard of Regina. Their work identified blowout and parabolic dunes as the most common types, as well as "windpits, deflation areas, circular, V- and U-shaped, shield, ridge-sided and fishhook dunes as well as elongated border ridges" (Mollard 1990:6). Various types of dunes also combine to form complex dune associations.

There are few waterbodies within the Great Sand Hills. The presence of several dry lake and slough beds attests to former conditions of higher



SOURCE: Epp and Townley-Smith, 1980

GREAT *SAND* HILLS
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Environment, Conservation and Public Safety

Manitoba

- SANDFLATS
- LOW STABILIZED DUNES
- HIGH STABILIZED DUNES
- SANDFLATS-LOW DUNES
- SANDFLATS-HIGH DUNES
- LOW-HIGH DUNE COMPLEX
- ACTIVE COMPLEX
- LAKE BEDS

LANDFORMS 2

precipitation. These shallow water bodies are in fact the surface manifestation of a high ground water table. The coarse texture of the sandy soil leads to rapid internal drainage of any precipitation. This high degree of infiltration combined with low rainfall and snowfall have prevented the development of a surface drainage system. There are no streams, creeks or rivers within the northern section of the Great Sand Hills.

The Saskatchewan Institute of Pedology has classified the soils of the area as being susceptible to wind erosion, once surface disturbance has taken place. The sparse ground cover, limited organic material, low moisture holding capacity of the soil and broken topography create a situation of great sensitivity to disturbance.

The Great Sand Hills have been largely uncultivated due to the sandiness of the soil and the sharply divided topography. The land is much more suited to grazing than to cereal crop production.

The rugged topography has presented a constraint to settlement and road development with the result that only one road crosses the Hills, and all ranches are located at the periphery.

The sensitivity of the Great Sand Hills to disturbance presents a constraint to a variety of human and economic activities including cultivation, settlement, grazing and intensive infrastructure development.

The Saskatchewan Parks System Plan has identified that the Great Sand Hills natural zone is currently not represented in the parks system. The Parks System Plan recommends that representative and unique portions of the Great Sand Hills be protected pending the results of the public review process for the Land Use Strategy.

2.3 Flora and Fauna

The Great Sand Hills are a unique ecosystem rich in flora and fauna. The moratorium area probably contains the greatest expanse of native vegetation in the Great Sand Hills which, combined with the rugged terrain, provides excellent habitat for many species of wildlife. The rough terrain and sandy soils have prevented significant agricultural cultivation, urban or industrial development. This has resulted in an island of relatively intact native prairie surrounded by cultivated lands.

Epp and Townley-Smith (1980) produced a list of the vertebrate fauna of the Great Sand Hills. They reported that the Great Sand Hills are home to five species of amphibians, 70 species of birds and 19 species of mammals. No reptiles were found in their study.

At least three species of animals found in the Great Sand Hills are classified by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as threatened, rare or endangered. These are: ferruginous hawks (*Buteo regalis*), burrowing owls (*Speotyto cunicularia*) and

prairie long-tailed weasels (*Mustela frenata*). Ferruginous hawks are found throughout the sand hills whereas burrowing owls are distributed mainly around the edge and in the flat areas. The distribution of the long-tailed weasel has not been determined. Ord's kangaroo rat (*Dipodomys ordii*) is a desert adapted animal unique to sand hill areas (Epp and Townley-Smith 1980:83). The distribution and status of the Ord's kangaroo rat have not yet been determined, and therefore the species has not been classified by COSEWIC. Other endangered or threatened species such as piping plovers (*Charadrius melodus*) and loggerhead shrikes (*Lanius ludovicianus*) may occupy portions of the Great Sand Hills for periods of the year. The importance of the Great Sand Hills area for these species is unknown.

The distribution and status of game species in the Great Sand Hills are well documented. Important game species include: mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), pronghorn antelope (*Antilocapra americana*) and sharp-tailed grouse (*Pedioecetes phasianellus*). Hunting is an important land use practice in the Great Sand Hills, and is described in detail in Section 3.4.

The distribution and density of plant species in the Great Sand Hills are determined by several factors including: climate, topography, aspect, depth to groundwater, the present state of soil activity (stabilized versus destabilized) and current land use. A detailed inventory of the flora of the Great Sand Hills was not attempted in preparing this land use plan. However, a gross vegetation map was prepared using 1:80,000 and 1:24,000 scale airphotos (Mollard et al. 1990).

Previous vegetation surveys were also used to describe the vegetative resources of the Great Sand Hills. A sample plant species survey was conducted in the Great Sand Hills in the 1970s by Epp and Townley-Smith (1980). They developed a list of vascular plants, but did not attempt to map species distribution in the entire Great Sand Hills.

Deciduous trees found scattered throughout the Great Sand Hills are primarily plains cottonwood (*Populous deltoides*) and trembling aspen (*Populous tremuloides*) (Mollard et al. 1990). Both species are indicative of moist habitats. The largest area of plains cottonwoods occurs in the southwestern portion of the moratorium area and has been designated as a Special Use Zone (see section 3.1).

Dense growths of shrubs are also found in the Great Sand Hills including: sage brush (*Artemisia cana*), rose (*Rosa sp.*), snowberry (*Symphoricarpos occidentalis*), wolf willow (*Elaeagnus commutata*), creeping juniper (*Juniperus horizontalis*), bearberry (*Arctostaphylos uva-ursi*), choke cherry (*Prunus virginiana*) and Saskatoon berry (*Amelanchier alnifolia*).

The dominant grass species present include: spear grass (*Stipa comata*), sand grass (*Calamovilfa longifolia*), june grass (*Koeleria cristata*) and wheat grasses

(*Agropyron sp.*). Blue grama (*Bouteloua gracilis*) is also present but less dominant.

A variety of perennial forbs are also found in the Great Sand Hills, with hairy golden aster (*Chrysopsis villosa*) being one of the most common. Others include: skeletonweed (*Lygodesmia juncea*), yellow flax (*Linum rigidum*), wild begonia (*Rumex venosus*) and scurf pea (*Psoralea lanceolata*). Scurf pea and wild begonia are usually the first to invade active sand surfaces.

Six plant species considered to be rare in Saskatchewan have been found in the Great Sand Hills (Epp and Townley-Smith 1980). Downingia (*Downingia laeta*) has been found at Crane Lake and Skull Creek. This plant has not been found anywhere else in Western Canada (Epp and Townley-Smith 1980:39). The other rare plants are yucca (*Yucca glauca*), which may have been introduced to the area, annual skeletonweed (*Lygodesmia rostrata*), prickly milk-vetch (*Astragalus kentrophyta*), small lupine (*Lupinus pusillus*) and Schweinitz's cyperus (*Cyperus schweinitzii*).

In addition to completing a plant species survey, Epp and Townley-Smith (1980) were able to identify 11 vegetation communities in the Great Sand Hills according to landscape type and aspect. The major vegetative-landscape units were dunes, sand flats, erosion areas, deposition areas and aspen understory areas.

2.4 Air Quality

The quality of air can be described by the amount of foreign gaseous and particulate material present. Monitoring of air quality in Saskatchewan has focused on urban centres and larger facilities which burn fossil fuels or emit particulates from production processes. Swift Current is the only location in southwest Saskatchewan where air quality is monitored.

The main sources of air emissions in the Great Sand Hills area include: gas wells, compressor stations, vehicle motors and the sodium sulphate plant at Ingebrigt Lake. Emissions from these sources are not considered to be a concern to human health nor to plants and animals. Emissions from burning of fossil fuels may in future be subject to additional regulation, if further steps are taken to control greenhouse gases.

Gas well development and operation: Natural gas may escape to the atmosphere during development of a gas well and during blow-down. Gas may also escape if there are leaks in fittings. Natural gas, which is lighter than air, expands quickly and therefore dissipates into the atmosphere. Precautions are taken around wells and compressor stations to prevent gas leaks and possible explosions.

Compressor stations: Natural gas, which is burned at compressor stations to drive the pumps, is mainly composed of methane. The main products of burning natural gas are carbon dioxide, water and nitrogen oxides. Nitrogen oxides can combine with water vapour in the atmosphere and result in acid precipitation.

Emissions from compressor stations are not currently regulated. Three stations in the vicinity of the Sand Hills were permitted under *The Air Pollution Control Act*. This Act was replaced by *The Clean Air Act* which exempts oil and gas facilities because they are regulated under *The Oil and Gas Conservation Act*. Construction plans for compressor stations are reviewed by the Department of Energy and Mines and must meet requirements of *The Boiler and Pressure Vessel Act*.

Nitrogen oxide emissions from the three licensed compressor stations range from an estimated 150 to 377 tonnes per year. There are about 40 compressor stations in the Swift Current region. Assuming nitrogen oxides emissions average 200 tonnes per year per station, the maximum volume for the 40 stations could be 8,000 tonnes per year. This can be compared with the Poplar River Power Station which emits an estimated 13,000 tonnes per year of nitrogen oxides.

Sodium sulphate plant: The sodium sulphate plant at Ingebrigt Lake dries product by burning natural gas. Emissions from the plant are the by products of burning, carbon dioxide, water and nitrogen oxides and particles of sodium sulphate which escape from the drying process. These emissions are not considered to be a concern to human health or to plants and animals. The plant operates under an approval issued under the Mineral Industry Pollution Prevention Regulations.

Other sources of air pollutants: Soil particles which are picked up by wind can impair visibility in southwest Saskatchewan, especially during spring and summer. Stationary and motorized vehicle engines are other sources of emissions. Again, these sources are not considered to have major effects on the health of humans, plants or animals.

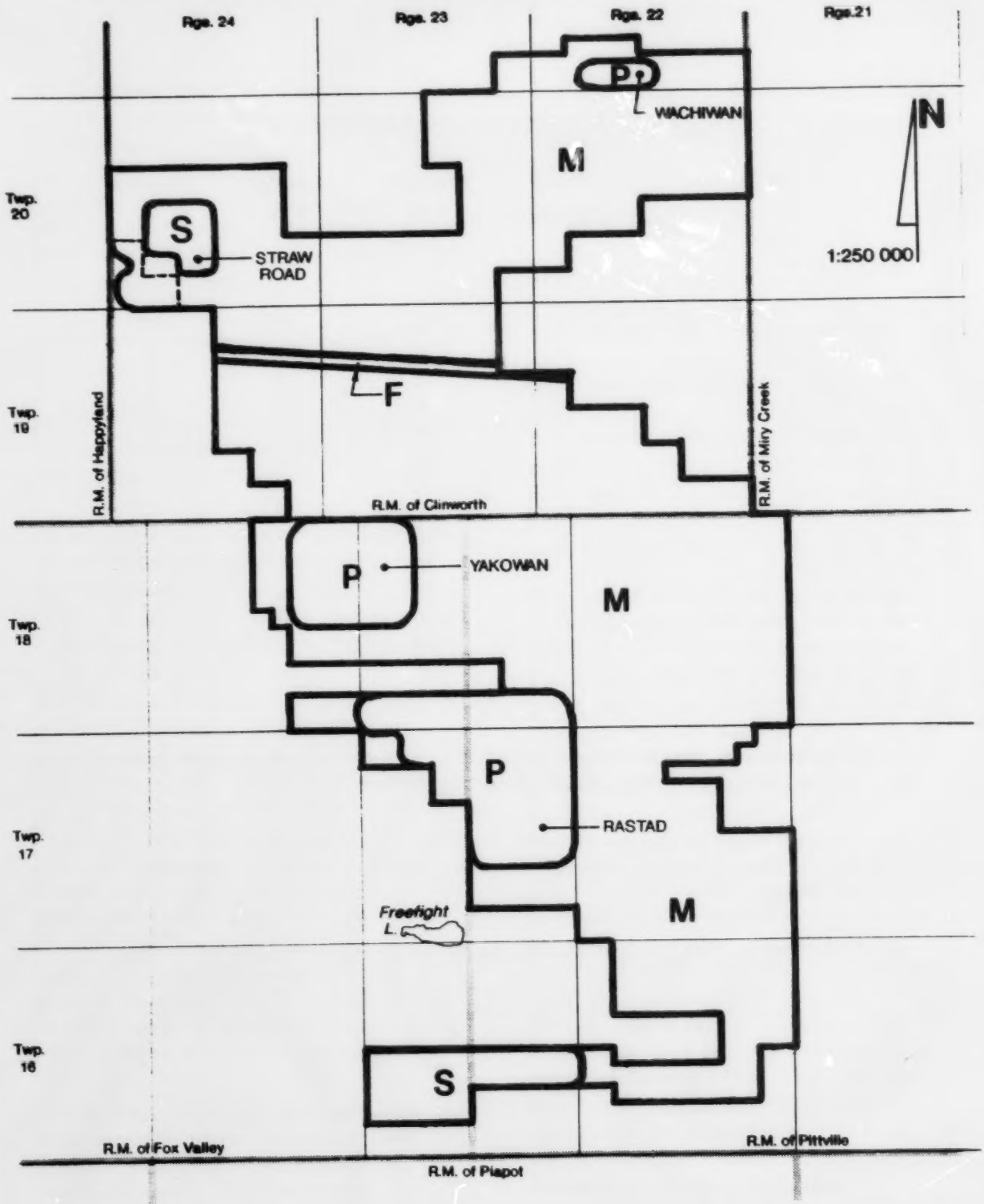
In conclusion, the impacts of known sources of air emissions in southwest Saskatchewan do not warrant any additional regulation at this time. Any changes to provincial and national regulations would apply to facilities in the area and to motorized vehicles. Therefore, no specific changes are recommended in this report.

3. Land Use Practices and Guidelines

3.1 Land Use Zoning

Land zoning is a planning tool that uses designations of land for varying degrees of protection, management and development. Four zones or types of area are recommended to guide management and development of the Great Sand Hills (see Map 3). These are the Prime Protection Area, Special Use Area, Multiple Use Area, and the Facility Area.

AREA	INTENT OF THE AREA
Prime Protection	To preserve environmentally sensitive terrain and biological and heritage resources.
Special Use	To protect unique areas or features by providing specific guidelines as required, and to accommodate uses which are not provided for within any of the other zones.
Multiple Use	To provide for the management and development of the full range of available resources, while ensuring the protection of physical, heritage and biological resources of the Great Sand Hills.
Facility	To recognize existing facilities such as ranches and pipelines and to provide for future facility development areas.



ZONES

M MULTIPLE USE
S SPECIAL USE
P PRIME PROTECTION
F FACILITY

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UMA

PROPOSED LAND ZONING 3

FIGURE 2 COMPATIBLE ACTIVITIES BY LAND USE AREA

AREA	Prime Protection	Multiple Use	Special Use	Facility
ACTIVITY				
Hunting	Y	Y	M	M
Trapping	Y	Y	M	M
Primitive Camping	M	M	M	M
Intensive Recreation	N	M	M	M
Off-Road Vehicle Use	N	M	M	M
Non-motorized Vehicle Use	M	Y	Y	Y
Scientific Study	M	Y	M	Y
Domestic Grazing	Y	Y	Y	Y
Cultivation	N	N	N	M
Natural Gas Development	N	Y	M	M
Mineral Development	N	Y	M	M
Recreation Trails	M	M	M	M
Transportation and Utility Corridors	N	Y	M	M

Y Uses that are considered to be compatible with the intent of a land use area under normal guidelines and land use regulations.

M Uses that may be compatible with the intent of a land use area under certain circumstances and under special conditions and controls where necessary.

N Uses that are not compatible with the intent or capabilities of a land use area.

3.1.1 Prime Protection Areas

Objectives:

To protect representative examples of the Great Sand Hills grasslands ecosystem and the processes that are required to sustain them.

To protect representative examples of the heritage resources of the Great Sand Hills.

To provide areas for wilderness recreation.

To provide bench mark areas to monitor the effects of management practices on adjacent areas.

The Purpose of Prime Protection Areas:

The purpose of Prime Protection Area designations is to provide guidance and legislation to manage specific areas within the Great Sand Hills to protect unique features and provide a variety of opportunities. The most immediate effect of designation of areas as Prime Protection would be to prevent gas development in these areas. The government of Saskatchewan would be required to negotiate return of sold mineral leases in Prime Protection Areas to the Crown. Mineral holders should be fairly compensated for these leases.

Three areas have been recommended for designation as Prime Protection Areas. These are the Yakowan, Rastad and Wachiwan areas. The boundaries identified below are subject to review by the appropriate agencies during negotiations for the purchase of mineral dispostions.

Yakowan Area

The Yakowan area is located approximately 23 km northeast of the town of Fox Valley. The total area proposed for withdrawal from gas development is 3,108 hectares (7,680 acres) including sections 23, 24, 25, 26, 35 and 36 of Township 18, Range 24, and sections 19, 20, 29, 30, 31 and 32 of Township 18, Range 23. Natural gas leases for 9 sections of the area have also been sold, but not yet developed.

The Yakowan area contains the largest active dune complex in Saskatchewan south of the Athabasca Sand Dunes. These spectacular land features provide opportunities for sightseeing, education and research. The absence of man-made facilities and the vastness of the site create a feeling of remoteness or solitude, providing a wilderness experience.

The Great Sand Hills area is one of only five natural sites in Saskatchewan that are considered to be of Canadian significance (Mondor 1985:114). Natural sites of Canadian significance are areas that are either rare or unique, or are classic examples of a particular natural feature (Mondor 1985). The Yakowan area would appear to qualify as a significant site under both criteria as it is a relatively rare natural feature, and a classic example of a sand dune vegetation complex.

Rastad Area

The Rastad area is located approximately 24 km east of Fox Valley. A 21 section area is recommended for withdrawal from gas development. This includes: Sections 25, 26, 27, 28, 32, 33, 34, 35 and 36 of Township 17, Range 23, West of the Third Meridian. An additional 12 sections bordering this area will be selected during negotiations. Natural gas leases for most of the area have also been sold, but are not yet developed.

The Rastad area is proposed as a Prime Protection Area because of its remoteness, rugged topography and the value of the area for wildlife. It contains some of the best examples of longitudinal dunes in the Great Sand Hills. The Rastad area is rated as exceptional habitat for mule deer.

A continuous block of land is recommended to provide a relatively large, undisturbed area. During the development of this strategy, many individuals and interest groups expressed a desire to establish undeveloped areas in the Great Sand Hills for aesthetic purposes.

Wachiwan Area

The Wachiwan area is located in the northeastern portion of the Great Sand Hills. The area recommended for withdrawal from gas development consists of the south 1/2 of Section 4 and the SE 1/4 of Section 5, Township 21, Range 22, West of the Third Meridian. The total area recommended for withdrawal from gas development is 194 hectares (480 acres).

The name "Wachiwan" means "it is hilly" in Cree. This is an accurate description of this area because the terrain is very rugged and the dunes are exceptionally steep. The area contains high stabilized dunes and a small area of active dunes.

3.1.2 Special Use Areas

Designation of areas as Special Use Areas and subsequent development of area-specific development guidelines may be the most effective mechanism to protect localized features inhabited by rare species. For example, certain areas should be avoided during nesting periods for ferruginous hawks. Identification of such areas in advance of development or use of the areas is desirable. This can be accomplished through biophysical inventories and environmental assessments.

Establishment of Special Use Areas would not require any legislation or land ownership changes. Rather, this zoning can act as a signal to alert developers or land users to special circumstances that may be required in certain areas. Special Use designation could also be used to protect the Straw Road area from major industrial development but permit some recreation facility development.

Four areas are recommended to be zoned as Special Use areas. These are the Straw Road and Cottonwood areas, Crane Lake and Skull Creek. Other areas may be identified as Special Use

Areas when detailed development proposals are prepared.

Straw Road Area

The Straw Road area of the Great Sand Hills is located approximately 19 km south of Sceptre. It is recommended that the following 3 sections of land be withdrawn from gas development: N 1/2 and LSD 1, 2, 6 and 7 of section 8, N1/2 and SW of section 9, NW of section 16 and S1/2 and NE of section 17 of Township 20, Range 24, West of the Third Meridian. Two sections are currently under mineral disposition which would need to be purchased by the government.

The concentration of landform types and vegetative communities combined with location and access make the Straw Road area attractive for interpretative and educational uses. The most spectacular landform features of this area are the active sand dunes. The area is popular with visitors who wish to see or hike in the active dunes. The scenic value of this area should be maintained.

Cottonwood Area

The Cottonwood area is a large area of open cottonwood woodland. Large trees are scattered in the interdune sand flats. The area is an important bird nesting site and provides shelter to deer and other wildlife. Development in this area should proceed in a manner that does not jeopardize the habitat or disturb wildlife during critical periods.

Crane Lake

The Crane Lake area may support nesting piping plovers (*Charadrius melodus*). This ground nesting, endangered bird is particularity sensitive to development and disturbance during the breeding season. The use of the Crane Lake area by piping plovers and other shore birds should be determined so that effective development guidelines can be established.

The Crane Lake area supports the rare plant species, *Downingia*. Its distribution should be determined and appropriate development guidelines established.

Skull Creek

The Skull Creek area is also known to be inhabited by *Downingia*. The distribution of *Downingia* in this area should also be determined and development guidelines established.

3.1.3 Facility Areas

The Facility Area is to recognize existing facilities in the Great Sand Hills. These include ranches, pipelines, roads and other utilities. Construction of buildings is an example of an activity that would be permitted in a Facility Area but may not be permitted in the other zones.

It is recommended that TransCanada PipeLines work to define a facility corridor to meet their future needs.

3.1.4 Multiple Use Areas

The Multiple Use Area consists of all areas not zoned as Prime Protection, Special Use or Facility. The Multiple Use Area is the largest area of the Great Sand Hills. In this zone, traditional land uses such as grazing and hunting will continue. New land developments such as gas exploration and development may be allowed subject to Provincial Government and Rural Municipality approval.

Specific Recommendations:

1. Establish the Yakowan (12 Sections) and Rastad (21 Sections) Areas as Prime Protection Areas to protect these sensitive landscapes from significant alteration, to protect examples of the variety of landforms that exist in the Great Sand Hills and to provide undeveloped areas for individuals seeking wilderness or solitude opportunities.

2. Establish the Wachiwan Area (3/4 Section) as a Prime Protection Area to protect its sensitive landscape from significant alteration.

3. Establish the Straw Road Area (3 Sections) as a Special Use Area to protect the sensitive landscape from significant alteration and to provide for recreational opportunities such as picnicking and hiking.

4. Establish the Cottonwood area, Crane Lake, and Skull Creek as Special Use Areas and establish development guidelines for these areas. This will require surveys for rare, threatened and endangered species.

3.2 Grazing Management

Specific Objectives:

To manage the range to ensure the long term viability of the native prairie.

To enhance the economic viability of farms and ranches.

To ensure that livestock production is compatible with other land use objectives including: petroleum and gas development, wildlife management and recreation.

To develop range management education programs for community pasture managers, patrons and grazing lease holders.

To establish community pastures as centres of excellence in sustainable range management, grass management, ecological stability and biological diversity.

Description of the Resource:

Within the Great Sand Hills complex there is one community pasture and many grazing leaseholds. The Millie pasture is approximately 24,537 ha (60,630 acres) of which 3,136 ha (7,750 acres) are improved pasture. Just over

132,000 ha (300,000 acres) of grazing land are under lease in the Great Sand Hills of which 79,075 ha (195,394 acres) fall within the study area. Four grazing associations are part of the leasehold mix. These include the Sandhills Stockmans (6,064 acres), Signal Valley (8,067 acres), Lemsford (5,834 acres) and the Heck (8,147 acres) grazing cooperative (see Map 4).

Native grass species sustain the 60 livestock grazing operations in the Great Sand Hills. The dominant grass species are listed in Section 2.3. Shrubs are also present which provide some shelter from temperature extremes. A variety of forbs are also found in the Great Sand Hills.

Typically five to seven cows with calves can graze a quarter section of average, native sand hill grassland for a grazing season of about 150 days.

The economic impact of cattle grazing on provincial Crown lands is important to Saskatchewan. An entire segment of the Saskatchewan cattle industry is now dependent upon these large tracts of public land. The Great Sand Hills are an important provincial resource for the livestock industry.

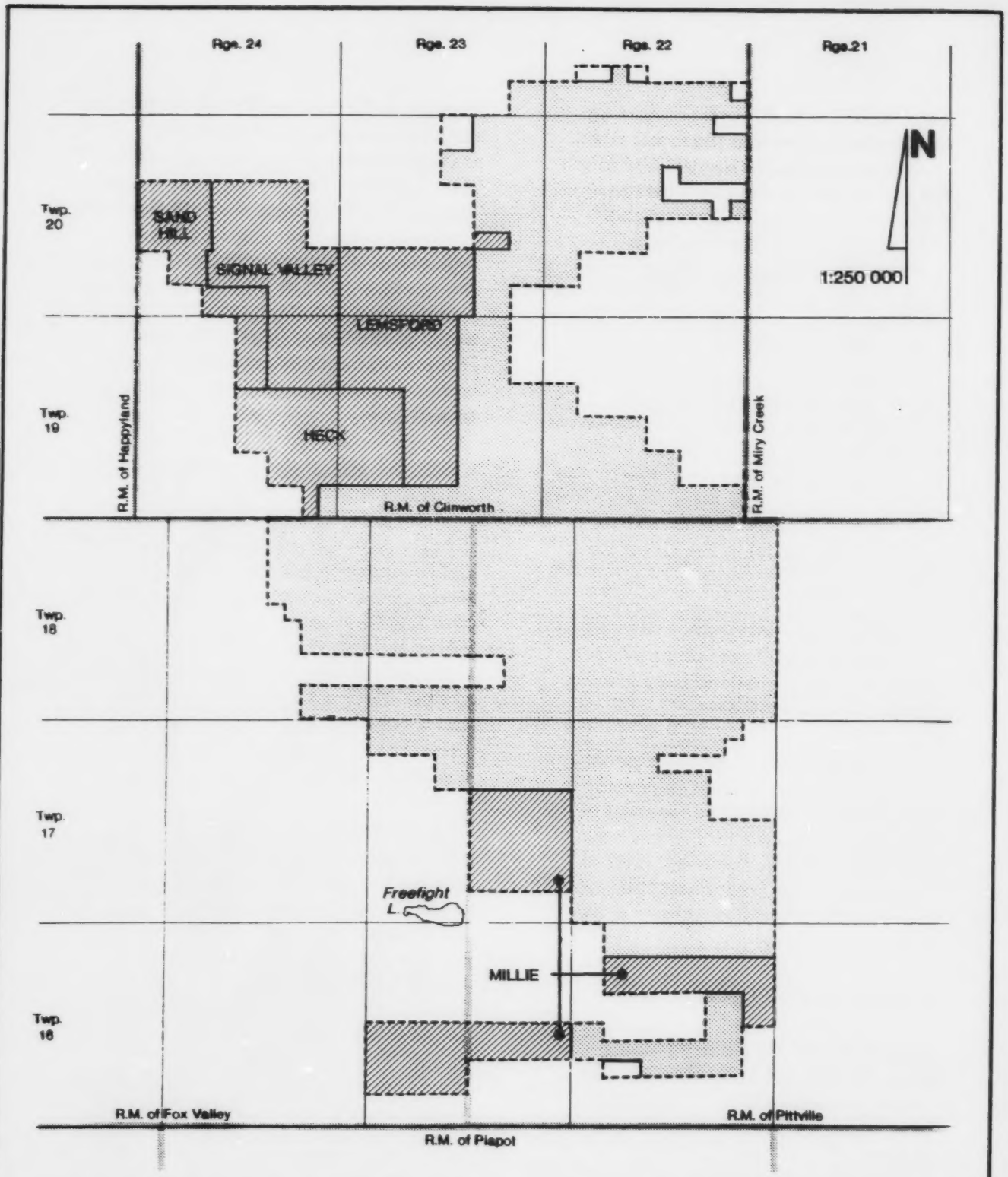
Constraints and Opportunities:

Grazing levels are greatly influenced by many factors including: climate, size of cattle, number of water sites, time of year, history and current management practices.

Numerous factors are climate driven and constrain the growth of preferred grazing species. Many grasses require years to grow and recover from drought. This greatly constrains the rate at which livestock production might grow. As well, many of the enhanced grazing practices reported in the abundant range management literature have never been tested in the Great Sand Hills area. Direct experience is lacking and results from other regions may not be readily transferable.

Cattle size affects the demands upon the grazing resource. Typically, grazing capacities are based on a 454 kg (1000 lb.) cow with calf. However, new breeds and modern rearing have produced a brood cow that often exceeds the 454 kg base line by as much as 30%. Moreover, calves are now larger and tend to shift to a greater proportion of grass and forage in their diets at younger ages. These factors challenge the currently set carrying capacities and strain the available grasses.

The number of water sites directly constrains grazing activity. Light or inadequate grass utilization occurs much beyond one kilometre from an established water site. In practice, this results in uneven grazing pressure across a field of native grass. Those areas near water receive heavy grazing while those further away receive light usage. This local overgrazing slowly alters species composition and shifts the sward away from climax to a more weedy species composition.



GREAT *SAND* HILLS

Integrated Land Use Plan

PASTURES / CROWN LAND

PRIVATE LEASES / CROWN LAND

Environment, Conservation and Public Safety

LAND TENURE

4

Water development, fencing and enhanced cattle management practices provide opportunities for additional grazing. As market forces move farmers away from a grain based economy, interest in and demand for cattle grazing will likely grow. As well, there is always a latent demand for cattle grazing at cost effective rates. These factors keep grazing pressures in a state of flux and continually keep producers under pressure to maximize resource use.

Management Practices and Guidelines:

Community pastures are managed by Rural Development Lands Branch as enabled by *The Rural Development Act* and *The Provincial Lands Act*. Three policies guide the operations and allocation of community pasture services. The Livestock Allocation, Management and Fee Schedule allocates grazing privileges, establishes fees and sets conditions for managing livestock within the provincial community pasture system. The Provincial Community Pasture Breeding Program supports the breeding of adult cows and promotes the active participation of producers in the breeding and service program. The Sheep Allocation Management and Fee Schedule sets the allocation procedures and fee schedule for sheep pastures and is similar to the cattle policy except where differences are dictated by the type and class of animal.

Allocations within the community pasture system are assured without requalification as long as the patron continues active participation in farming.

Pasture activities are budgeted and administered locally with building maintenance, fence development, water site construction and cattle management comprising the major activities.

The annual operational life cycle at a community pasture consists of taking in patron cattle, distributing these among the various fields, overseeing the quality and condition of the grass species, moving cattle as required to maintain fifty percent grass cover usage, ensuring adequate water and reassembling cattle for take out procedures. Bulls are released appropriate to the breeding season and regathered following the close of breeding. As well, sick cattle are tended to as required. Documentation and records of movement for billing purposes are also maintained.

A producer advisory committee exists for each community pasture. These committees provide advice to the manager and the local land representative and make recommendations on grass conditions, field use and water site development. They also help establish dates to move livestock on and off the range and serve as a sounding board for new ideas.

A district land representative is available to provide advice on stocking rates and land development, and to identify pasture specific needs and management practices.

On leased land, users demand favourable land rental rates while the public expects a return from the provincial resource.

Currently, the balance between use and charges is left to a rental formula. *The Provincial Lands Act* and the Provincial Lands Regulations, set the terms and conditions under which Crown lands are leased to the end user.

The application of the rental formula results in a dollar/cow/month figure that when multiplied by the number of cow-months associated with a particular lease, sets the rental for that lease for that year. Each year, market figures are updated and the rentals are recalculated.

The number of cow months associated with a lease are determined by professional agrologists and this number reflects the productive potential of that land with minimal management inputs. To determine the number of cow months for a particular range site, agrologists compare that site to a bench mark site at which forage production has been measured. Forage production estimates from the bench mark site are adjusted on the basis of relevant site characteristics such as soil texture, slope, aspect, vegetation, stones and drainage. These estimates are not adjusted for year-to-year climatic fluctuations.

For leases issued prior to 1965 and still in effect, the rental charge is based on a previous formula that groups lands of similar productive potential into classes, and charges rental on a per acre basis. The rate for each class is based on the Winnipeg market prices of cattle and higher rates are associated with higher (more productive) classes of land.

The agencies that are responsible for assessing grazing land in Saskatchewan are: Saskatchewan Rural Development, Rural and Agricultural Services and the Saskatchewan Assessment Management Authority. Other agencies include: Prairie Farm Rehabilitation Administration, Saskatchewan Crop Insurance, and the Saskatchewan Soil Survey.

These agencies use different methods for assessing grazing rentals. Determination of range carrying capacity is essential to effective range management and therefore standardization is necessary among the agencies.

Grazing capacity is defined as the average number of grazing animals that can graze the range year after year without damaging the vegetation or soils. Stocking rate is the actual number of animals or animal units on a specific piece of rangeland or field for a specific period of time.

Proper stocking rates ensure uniform use of the range, allow for carryover of ungrazed plant material and produce healthy animals. Stocking rates are best established at 80% of the carrying capacity as described by Abougendia et al. (1990:18). Establishing stocking rates depends on soil, kind of vegetation, initial stocking rate and current range condition.

Range condition is determined by comparing the current or present state of a range site to a specific bench mark

or reference point. The reference is usually a natural or climax sward of native or undisturbed vegetation. Range condition is an expression of range health.

Range condition is divided into four classes based on the presence or absence of plant species that are described as decreasers, increasers or invaders. Excellent range condition is found where original vegetation contributes more than 75% to the total yield. Good condition occurs where original vegetation comprises 50 to 75% of the production in the range site. Fair condition exists where 25 to 50% of the yield is composed of original vegetation and poor condition is where original vegetation represents less than 25% of the overall production.

Specific Recommendations:

1. The grazing resource needs to be maintained. This will require:

    a) standardizing the grazing assessment system;

    b) providing on-site pasture demonstrations, improving fencing practices and implementation of better grazing practices;

    c) providing training to grazing managers on new technologies and ideas on range use and cattle management;

    d) providing programs that maintain species diversity and the sand hills grassland ecosystem while maintaining the grazing resource; and

    e) providing programs that improve fence line development and water facility improvement.

2. Range management practices need to be improved for livestock and wildlife. This should be coordinated with other uses.

3. Research is required to determine the response of native grasses in the Great Sand Hills area to grazing, the season of use and timing of field use.

4. More agrologists who are trained in rangeland management with cattle management expertise are needed. Pasture managers also require range use training.

5. An expanded role for the community pasture system should be considered so that additional land uses are recognized and legitimized within the community pasture system. This will require:

    a) developing a vehicle access plan; and

    b) developing multiple land use objectives.

6. Lease agreements on Crown land need to reflect producer concerns and proper range management. Therefore, it is recommended that:

   a) adjustments to rental rates only proceed after careful analysis;

   b) any new rental formula discourage mismanagement of the range;

   c) lease rental adjustments parallel livestock market conditions;

   d) a formal appeal process be developed to allow due consideration for concerns on rental charges or land use conflicts; and

   e) ongoing range evaluation be conducted to ensure protection of natural resources.

3.2.1 Surface Leases:

Petroleum and gas companies must apply to the Department of Rural Development to obtain surface leases for the purpose of exploration or development of petroleum or gas resources. The Department provides a policy for charging for oil and gas activities, pipeline easements and for compensation for agricultural lessees. A separate policy outlines the requirements for completing seismic work on Crown land.

The issuance of surface leases gives surface rights to the oil and gas companies. Surface rights are defined in *The Surface Rights Acquisition and Compensation Act* as follows:

- the right to enter upon the land for the purpose of drilling or producing or recovering a mineral;

- the right to install and operate equipment used in connection with drilling or producing operations of a well;

- the right to restore the surface of the land that has been used in connection with:

(a) the drilling for, producing or recovering a mineral;

(b) the constructing, operating, maintaining or servicing flow lines, service lines or power lines.

Surface leases are required once a company is at the point of test drilling. Leases issued for petroleum and gas sites are shared 30% with the agricultural lessee. This share represents loss of acreage earnings, severance, nuisance, adverse effects and any additional charge for roads that extend beyond the wellsite quarter.

No surface lease is required for seismic work. Only written permission is required from the Department of Rural Development. For seismic operations, companies must negotiate compensation for right of entry, adverse effects,

nuisance and productivity loss with the agricultural lessee. Where land is not under lease or sale agreement, companies conducting work must obtain approval from the Rural Development prior to entry. A payment formula has been established that requires seismic operators to pay the Department for their activities. Companies must also contact municipal governments for project approval. Municipalities must be given prior notice and notice after work is completed.

Companies are responsible for all damages including fences and gates. Compensation for damages is to be paid directly to the lessee. Settlement with the lessee must be complete before obtaining a release from the Department.

3.3 Oil and Gas Exploration and Development

Specific Objectives:

To ensure the hydrocarbon resources in the development zones of the Great Sand Hills area are delineated and evaluated in a thorough manner.

To ensure the hydrocarbon resources are developed and produced such that the maximum economic value is obtained.

To ensure the hydrocarbon reserves are recovered with minimum disturbance to the biological, physical and cultural resources of the area.

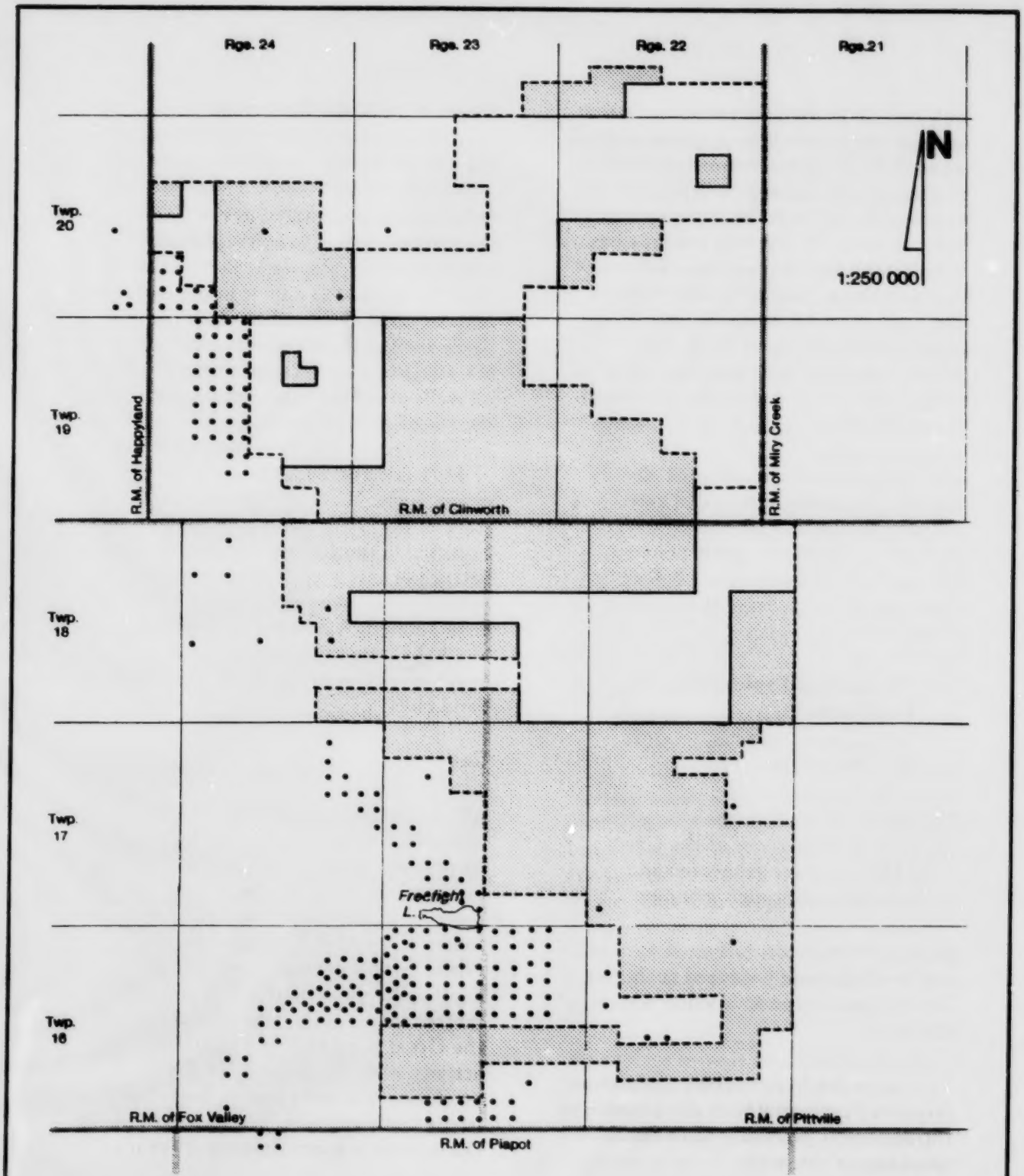
Description of the Resource:

Oil

Oil production potential in the Great Sand Hills appears to be very limited. The only oil development that has taken place in the area to date is in the extreme eastern tip of the southern block where there are 12 oil wells and 5 pressure maintenance (waterflood) wells. The 12 oil wells produce roughly 900 cubic metres of oil per month, generating gross revenues and provincial royalties of $172,000 and $49,000 per month, respectively. No oil exploration is taking place in the Great Sand Hills, and none is expected in the foreseeable future. The balance of this section, including the recommendations, address gas development. A detailed re-evaluation would be required should any oil development be proposed in the Great Sand Hills.

Gas

All of the Great Sand Hills area has potential for natural gas development. At present, mineral rights to 65% of the moratorium area have been sold. Gas reserves in the Great Sand Hills area are found in the Milk River and Second White Specks geologic horizons at depths of approximately 400 and 700 metres respectively. Gas production in the Great Sand Hills is a relatively new activity with the majority of the producing gas wells having been drilled in the last five years. The expected life of these wells is approximately 25 years.



GREAT *SAND* HILLS
Integrated Land Use Plan

• EXISTING GAS WELL

MINERAL DISPOSITIONS

MINERAL DISPOSITIONS 5

Natural gas development in the Great Sand Hills has largely been restricted to the less rugged fringe areas on the western and southern edges. The majority of production is in the Ingebrigt, Freefight, Crane Lake and Crane Lake South Gas Pools. The moratorium area is largely unexplored with only 24 wells having been drilled. Sixteen of these wells have been abandoned with the remaining 8 standing cased, but never having produced natural gas. In the northern block of the Great Sand Hills outside of the moratorium area, 140 active gas wells have been located mainly in the Liebenthal, Ingebrigt and Freefight Gas Pools. The southern block has been more extensively developed with about 320 wells producing gas in the Bigstick and Crane Lake areas.

Spacing of gas wells is determined by a number of factors. Well spacing in the Great Sand Hills varies from 1 well per 259 hectares (1 per section) to 1 well per 32 hectares (1 per 80 acres). Most areas are presently being drilled on 32 or 65 hectare spacings. The trend towards 32 hectare spacing can be attributed to a combination of increased reserves, high demand and maximization of recovery over the design life of the facilities. All of these factors, in addition to environmental and aesthetic factors, must be considered in determining gas well spacing.

Gas production in the Great Sand Hills is an important economic activity for Saskatchewan. Based on current gas production, reserve estimates in the Great Sand Hills area range from 10 to 60 million cubic metres per section, with an average of approximately 40 million cubic metres per section. The 140 gas wells in the northern block currently produce about 7 million cubic metres of natural gas per month (see Map 5). This generates gross revenues of $380,000 per month which provides provincial royalties of $23,000 per month, based on the present price of $55 per thousand cubic metres of gas. The 320 gas wells in the southern block produce approximately 51 million cubic metres per month, generating gross revenues and provincial royalties of $2,800,000 and $412,000 per month, respectively.

In addition to being important provincially, the gas industry is an important source of jobs for communities near the Great Sand Hills. Generally, gas well drilling accounts for 1.6 to 3.2 person-years of employment per section, with field operations generating an additional 0.16 to 0.32 years per section over the life of the development. Spin-off benefits are projected at an estimated 1.94 to 3.87 person-years per section.

Constraints and Opportunities:

There are many factors that constrain gas development in the Great Sand Hills. These include: rugged land features, sensitive landforms, arid climatic conditions which increase reclamation cost, multiple land uses which may conflict with gas development and high drilling costs that are associated with waste disposal and obtaining water. Gas

pricing, sales, and distribution polices also constrain gas development but are beyond the scope of this study.

Large portions of the Great Sand Hills consist of rugged, environmentally-sensitive terrain making access and construction difficult and reclamation very expensive. Extensive preconstruction planning is essential for project approval and to minimize reclamation costs. Even with detailed planning, topography and terrain sensitivity will likely prevent gas development from occurring in some areas of the Great Sand Hills. In some areas, the cost of reclamation may prohibit project development for purely economic reasons. Reclamation standards have been established for the Great Sand Hills and are presented in Section 3.9.

The uniqueness and sensitivity of the Great Sand Hills require careful storage and handling of gas production waste materials, again increasing development costs. Aesthetic considerations are also important in locating waste storage sites and the design of facilities. Handling of gas production wastes is primarily a cost constraint. Technically, it is quite feasible to manage wastes to protect the Great Sand Hills and locate facilities to minimize aesthetic impacts. Guidelines for handling gas production wastes are presented in the recommendation section.

The Great Sand Hills are a multiple-use area. As such, gas development may be constrained by other land users. For example, hunters or recreationalists are likely to be concerned with the loss of their wilderness experience if all areas of the Great Sand Hills have man-made industrial features. Noise from compressor stations could also impact upon outdoor recreation activities. There also is potential conflict between gas developers and livestock producers. While potential conflicts are dealt with in various sections of this land use plan, conflict resolution will need to remain largely the responsibility of developers and those most affected by development.

Despite the constraints that have been presented, there will probably be future proposals for gas development in the Great Sand Hills. Two key factors support this suggestion. First, there has been an increase in the demand for natural gas in the United States. Second, although the challenges of reclamation and waste management in the Great Sand Hills add to production costs, production of gas in this area is relatively inexpensive, as the gas is located in shallow, widespread reservoirs. Shallow gas wells can be drilled and cased in a single day, where as deeper reservoirs would require several days of drilling, greatly increasing costs. The wide-spread nature of the resource reduces exploration costs required to evaluate gas reserves.

One other factor that supports gas development in the Great Sand Hills is the nature of the gas itself. Gas produced in the Great Sand Hills is sweet gas; that is, gas that has a low sulphur content. This makes processing

relatively simple and inexpensive. Moreover, sweet gas is less toxic than sour gas, reducing public heath risks and concerns.

Management Practices and Guidelines:

Saskatchewan Environment and Public Safety has established guidelines for conducting seismic exploration, oil and gas development programs and for reclamation. These are provided to companies that have obtained mineral rights. On lands judged by the Department to be highly sensitive, project proponents are required to submit an Environmental Protection Plan (EPP) for review by various government agencies. If a project is deemed to have a significant environmental impact, a detailed Environmental Impact Assessment (EIA) must be carried out. On the basis of the assessment, the project will be approved with conditions, or rejected. Approved gas projects can proceed subject to *The Oil and Gas Conservation Act* and Regulations (administered by Saskatchewan Energy and Mines), and any other appropriate regulations.

In addition to the Act and Regulations governing oil and gas development, several sets of guidelines have been established. Energy and Mines has developed guidelines for the disposal of various drilling fluid wastes. These have not been specifically designed for the Great Sand Hills area, but are appropriate in this area. Energy and Mines and Environment and Public Safety have jointly developed guidelines for the handling of blow-down fluids and salt based drilling mud systems, which apply to the southwest area of the province.

Specific recommendations for gas development in the Great Sand Hills are provided in the following section.

Specific Recommendations:

1. All proponents should submit plans for any exploration or development in the Great Sand Hills to Environment and Public Safety.

    a) A detailed project proposal (EPP) will be required for any proposed seismic exploration or exploratory drilling in the moratorium area. The moratorium area is defined in Appendix C. Environment and Public Safety reserves the right to require a full Environmental Impact Assessment (EIA) for any exploration program if it is of sufficient scale, is in a sensitive area or otherwise satisfies any of the criteria in *The Environmental Assessment Act*.

    b) An environmental impact assessment will be required for any proposed gas-production program in the moratorium area. Development of all mineral holdings of that proponent in that area of the sand hills is to be addressed in the EIA. However, only the developments proposed for the

initial 2 years must be addressed in site-specific detail. Future development details would require subsequent approval, and would be reviewed prior to actual development occurring. This is assuming that the overall development received initial Ministerial Approval. No production development in this area will be permitted without the proponent first having received Ministerial Approval pursuant to *The Environmental Assessment Act* for the complete development area. Completion of an exploration program will not guarantee that Ministerial Approval will be granted for production development, nor will assurance be given that all site-specific development plans will be approved even if the overall project has received Ministerial Approval.

c) All exploration and development proposals in the Great Sand Hills outside the moratorium area will be subject to prior review of a project proposal by Environment and Public Safety. Any proposal which satisfies any of the criteria in *The Environmental Assessment Act* will be required to undergo an EIA and to obtain Ministerial Approval to proceed. An Environmental Protection Plan will be required for any project not requiring an EIA.

d) All plans for exploration and development in any part of the Great Sand Hills must be presented by the proponent to the appropriate Rural Municipality and to a public meeting or similar forum in the project area. These presentations must occur prior to the presentation of a project proposal or similar documentation to Environment and Public Safety for environmental screening. The Department retains the right to waive the public meeting requirement for small-scale exploration projects in less environmentally sensitive areas.

2. Well sites, flow-lines and access routes should be carefully sited to avoid areas with high erosion potential.

3. Drilling fluids should be contained in mud tanks used in association with a small transfer pit. Lined mud pits are not acceptable as they unnecessarily disturb stabilized soils and thereby increase the risk of erosion.

4. Drilling mud and drilling fracture fluids should be disposed of in accordance with Energy and Mines guidelines. Certain waste drilling fluids may be disposed on lease, on access trails and on pipeline rights-

of-way, so long as this is done in accordance with these guidelines. This practice is currently limited to gypsum and ammonium sulphate-based fluids. Potassium chloride based fluids may not be disposed on lease and must be either deep well-injected or disposed of in previously approved surface facilities.

5. Water co-produced with natural gas should be flow-lined to central facilities for handling and disposal when technically feasible. Detailed water-management plans should be presented in the EPP or EIA.

6. Flowlines should be installed in a manner which reduces surface disturbance (e.g., plowed in rather than trenched, wherever possible).

7. Access and pipeline rights-of-way should follow the existing trail network whenever possible, and should use a common right-of-way. New rights-of-way should be used only where existing routes are not available and where use of existing trails would increase overall environmental impact.

8. Development activities should minimize habitat loss and avoid areas of key wildlife habitat for priority species during high-sensitivity periods. Examples of sensitive species and areas include: raptor nesting sites, burrowing owl burrows, piping plover nesting areas, critical winter habitat for ungulates and sharp-tailed grouse dancing grounds.

   All development sites should be surveyed for rare and endangered species of flora and fauna. The results of these surveys should be included in the EPP and EIA.

9. Developers should provide an environmental monitor(s) on-site, full-time during all exploration and development activities to ensure that all environmental protection measures in the impact assessment or protection plan are implemented. Monitors should also assist the developer in anticipating and avoiding unforseen environmental impacts.

   The monitor should have the developer's written authority to halt exploration or development when in the monitor's professional opinion, unacceptable environmental damage could be done by the ongoing activity.

   Environment and Public Safety should have the right to approve project monitors.

10. All development sites should undergo heritage resource screening to determine archaeological sensitivity (see Section 3.6).

11. All disturbed areas should be stabilized and reclaimed using procedures and to the standards indicated in this plan (see Section 3.9).

12. All new gas development activities (aside from limited scale exploration or similar undertakings) in the Great Sand Hills should require posting of a bond or similar instrument with the Government of Saskatchewan. The amount of the bond or equivalent guarantee should be adequate to ensure effective reclamation of disturbed locations.

13. Gas developers and Rural Municipalities should cooperate in preparing fire prevention and control plans. These plans are to be presented in EPPs and/or EIAs.

14. Environment and Public Safety, Energy and Mines, Rural Development and other government departments as may be appropriate should inspect development sites at least annually to ensure that procedures and standards established in this strategy and in environmental protection plans and Environmental Impact Statements (EIS) are being followed or achieved. These inspections should continue until site reclamation has been completed satisfactorily. There is a need for more environmental inspectors with training in reclamation technology to undertake these inspections.

15. Developers should be encouraged to provide educational opportunities relative to their activities and the means by which environmental protection is accomplished. Such programs should include site visits in response to requests by environmental interest groups, local government officials and land owners/occupants.

16. Oil and natural gas mineral rights currently held by the Crown in the moratorium area, and any oil and gas rights which subsequently may revert to the Crown in this area, should not be offered for sale by Energy and Mines for a period of at least three years. Environment and Public Safety, Energy and Mines, and other government agencies will use experience with development in the moratorium area to determine if land withheld from sale should be made available in the future for development.

3.4 Wildlife Management

Specific Objectives:

To maintain the biological diversity of the Great Sand Hills.

To provide quality recreational opportunities such as hunting, bird watching and other wildlife based activities.

To ensure that the use of wildlife resources is sustainable.

Description of the Resource:

The Great Sand Hills provide some of the best mule deer habitat in Saskatchewan. Consequently, the area is one of the most popular for mule deer hunting. For management purposes, the area has been divided into two units, Zones 9 and 10. With average mule deer densities greater than 6.0/km^2, 3,400 licences were issued in 1989 in these two zones. This produced 5,800 mule deer hunter recreation days and a harvest of 3,000 mule deer. The moratorium area provides the best mule deer habitat in the area, and consequently draws the most hunters.

White-tailed deer and antelope tend to utilize the flatter areas around the periphery of the Great Sand Hills. Although not as numerous as mule deer, both white-tailed deer and antelope are significant game species in Zones 9 and 10.

Sharp-tailed grouse are an important game bird of the Great Sand Hills. They are especially valued by local residents. Sharp-tailed grouse spring densities in Zones 9 and 10 have ranged from about 1.2 to 4.2 breeding males/km^2 over the last five years.

Hunting opportunities in the Great Sand Hills are significant in both the numbers of individuals participating and the revenue generated from their activities. Hunters, particularly mule deer hunters, inject money into the local economy each fall. This has not been quantified in a regional context, but the 1988 Importance of Wildlife to Canadians survey indicates that big game hunters in Saskatchewan spend approximately $40.00 per day per hunter. With approximately 5,800 mule deer hunter recreation days in Zones 9 and 10, the total economic contribution to the local economy is significant.

More members of our society enjoy watching wildlife than are involved in hunting. The interest in this type of wildlife activity is steadily increasing. There is a therapeutic quality about observing all forms of wildlife in their own environment. The Great Sand Hills provide untapped opportunities, that if used properly, could provide excellent recreational experiences and economic spin-offs.

Constraints and Opportunities:

Wildlife populations are affected by habitat loss or degradation, and by disturbances which induce behavioral change. Effective, integrated management is essential to protect and promote wildlife populations, one benefit of which is hunting opportunity. Specifically, this will require developing grazing management plans that consider wildlife needs, preventing activities that significantly disturb wildlife, especially during breeding seasons or other critical periods, and consideration to further designation of critical wildlife habitat with lessee consent.

In addition to providing wildlife for hunters, the wilderness experience that currently exists in portions of the sand

hills should be maintained. This will require providing areas that are relatively undeveloped. In areas where development occurs, visual and aural impacts should be minimized and reclamation efforts should be directed to achieving a return to natural conditions where possible.

The wilderness experience currently offered by the Great Sand Hills provides recreational benefits to both hunters and non-hunters. The wildlife and natural landscape features could act as the foundation for increased tourism in the area. This is further discussed in Section 3.5.

During public meetings, individuals from wildlife organizations expressed concern regarding road development in the Great Sand Hills. They felt that a well developed road system could increase hunting pressure and increase wildlife harassment. Development of a vehicle access plan for the Great Sand Hills may be necessary to protect wildlife resources. This is examined in Section 3.10.

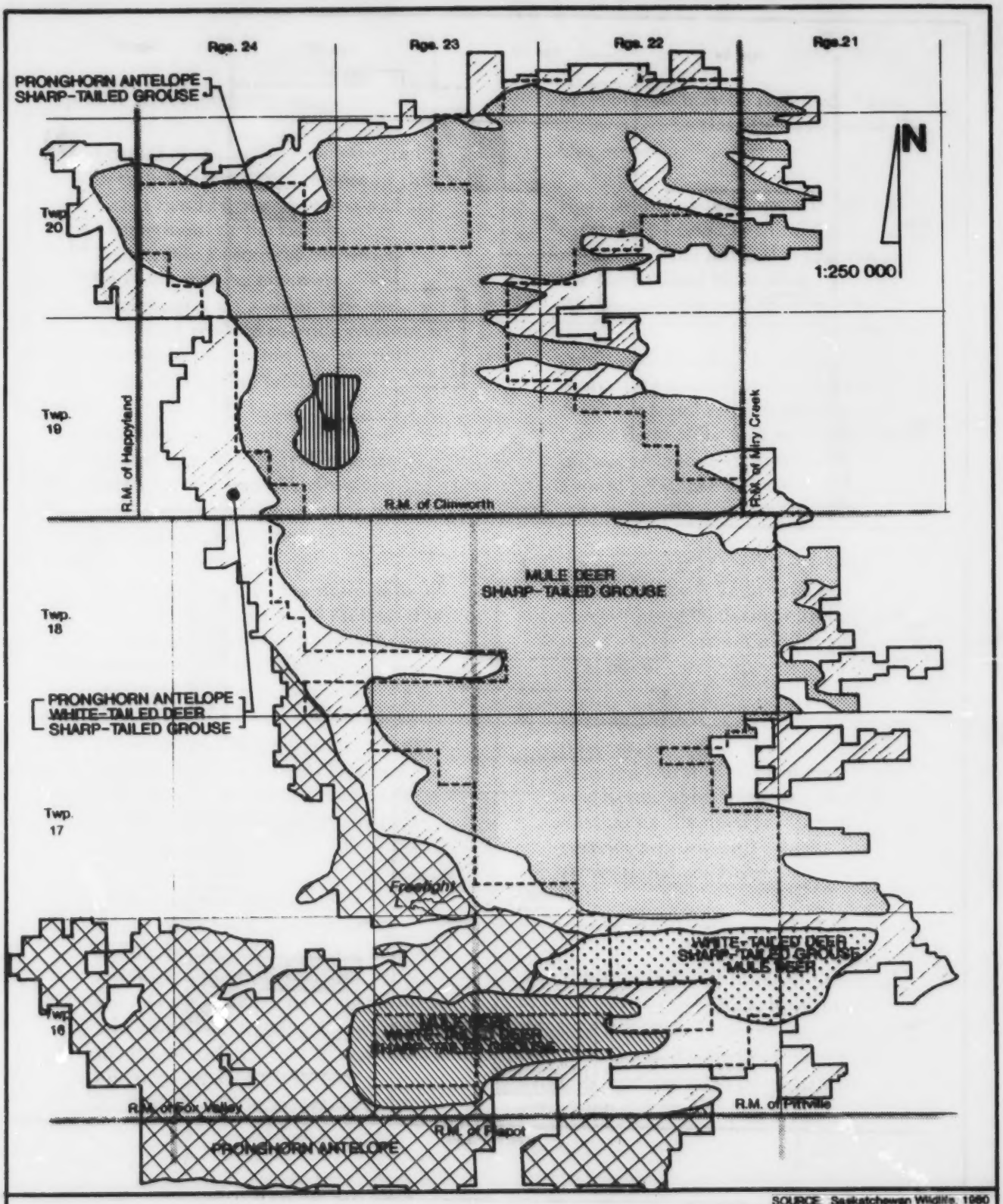
Management Practices and Guidelines:

Management of wildlife populations requires establishing and regulating hunting regulations and seasons. This is accomplished under the authority of *The Wildlife Act* and Regulations. This Act also provides authority to protect non-game species.

The entire Great Sand Hills were identified as critical wildlife habitat during the Terrestrial Wildlife Habitat Inventory (Hart and Hunt 1980, see Map 6). The survey established that a mule deer, sharp-tailed grouse rating was the dominant classification in the Great Sand Hills. Fringe areas are also important for antelope and white-tailed deer. The importance of the Great Sand Hills as critical wildlife habitat, plus the fact that a large portion of the area is Crown land, has resulted in almost the entire area being reserved from sale and major alteration. A total area of 103 km^2 has been formally designated under *The Critical Wildlife Habitat Protection Act* (see Map 7). Lessees have demonstrated concern regarding the proposed designation of the balance of the area as Critical Wildlife Habitat. Their concerns must be addressed before further designation occurs.

Designation of land as Critical Wildlife Habitat does not preclude gas development or interfere with traditional ranching operations. However, this designation prevents cultivation or other forms of major landscape alteration.

Management of wildlife populations in the Great Sand Hills requires assisting ranchers to prevent losses of hay and other crops to big game, or to partially compensate them for unavoidable losses. This is done in conjunction with the Wildlife-Landowner Assistance Program. Crop depredation is currently a major concern with farmers in and near the Great Sand Hills.

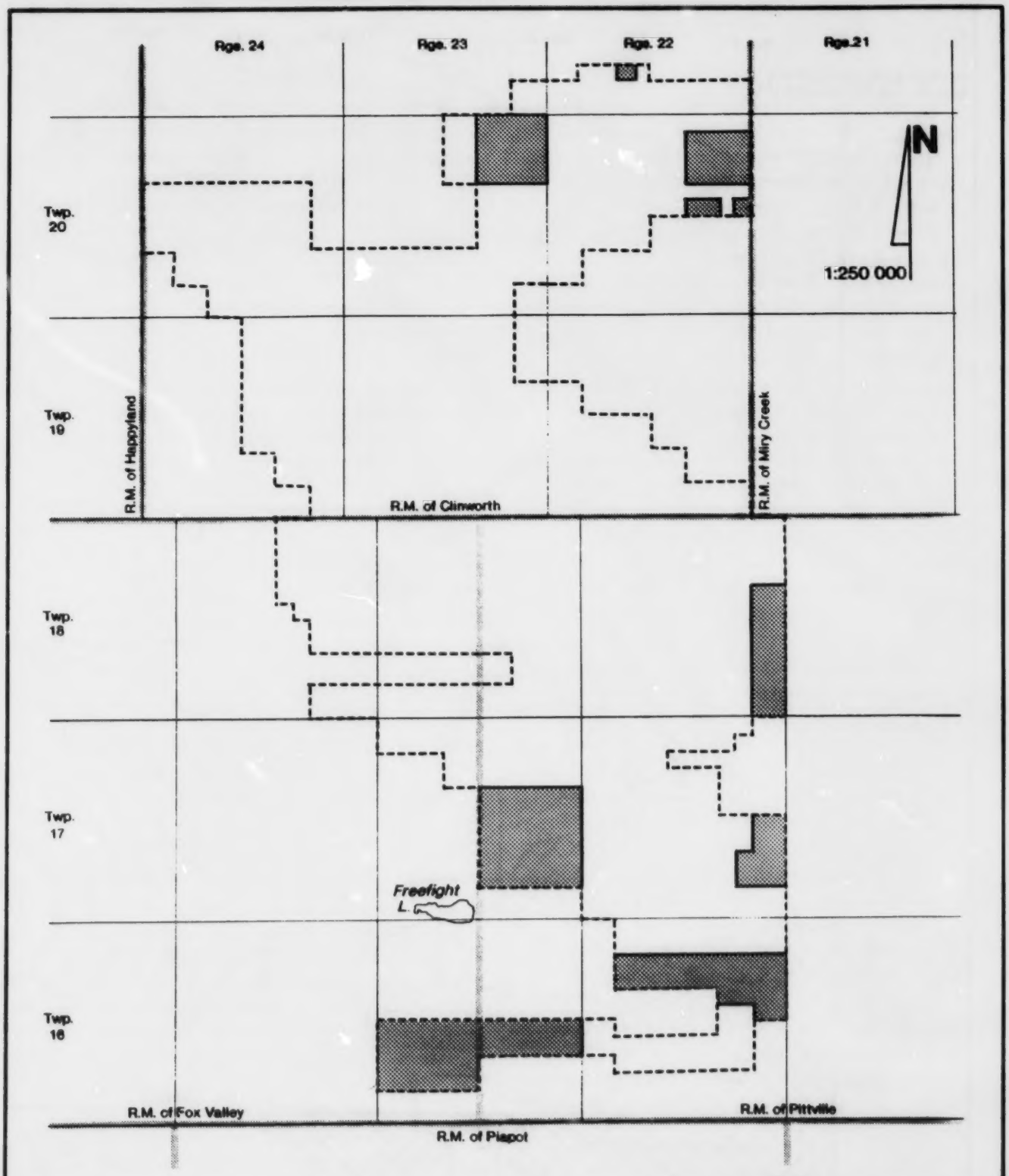


SOURCE: Saskatchewan Wildlife, 1980

GREAT SAND HILLS
Integrated Land Use Plan

CRITICAL WILDLIFE HABITAT CLASSIFICATION

6



DESIGNATED BY ACT

GREAT *SAND* HILLS
Integrated Land Use Plan

Saskatchewan Environment and Public Safety

CRITICAL WILDLIFE HABITAT DESIGNATION

7

Specific Recommendations:

1. Formal consultations are required between Crown land lessees in the Great Sand Hills and officials of the Department of Parks and Renewable Resources, in which lessees are to be given an opportunity on a voluntary and informed basis to provide consent to parcels of land being designated Critical Wildlife Habitat.

2. Wildlife and livestock managers should improve their working relationships to more closely manage range resources for both livestock and wildlife.

3. Hunting should be maintained in all areas of the Great Sand Hills as it is a sustainable use of the resource and an important wildlife management tool.

4. Development should proceed with minimization of habitat loss and disturbance to wildlife, and without sacrificing habitat quality, including water quality.

5. Prior to major development in the Great Sand Hills, the following should be identified: critical deer and antelope wintering/fawning areas, sharp-tailed grouse dancing grounds and associated nesting cover, and nesting/denning areas of rare and endangered species. Where identified, additional restrictions or prohibitions may be required. These areas could be classified as Special Use areas.

6. Road and trail development must be carefully planned to minimize impacts on the natural resources of the Great Sand Hills. (See Recommendation 7, Section 3.3.)

7. Additional research is necessary to more fully understand ecological conditions and relationships in the Great Sand Hills, and to predict the impact of land uses. Information should be stored in a central data system to allow access to users.

8. The potential of the Great Sand Hills to support additional non-consumptive wilderness and wildlife based recreation should be examined.

9. During periods of extreme fire hazards, in consultation with affected Rural Municipalities, Parks and Renewable Resources should determine the need to close or restrict hunting and other recreational activities.

3.5 Tourism

A detailed analysis of tourism potential in the Great Sand Hills is beyond the scope of this plan. However, tourism is briefly addressed here because it is an existing land use with potential for expansion.

Objectives:

To promote sustainable tourism of the Great Sand Hills without significantly impacting biological, physical and heritage resources or other existing land uses.

To protect both representative and unique landscapes.

Introduction:

Tourism is estimated to be the fastest growing industry in the world and is expected to be a growth industry in Canada throughout the 1990s. Tourism is currently a very important component of Saskatchewan's economy. Expenditures by tourists in Saskatchewan are between $650 and $750 million annually, generating 18,000 direct and indirect jobs (Tourism Canada 1990).

Saskatchewan is most frequently visited by Alberta residents who are among the highest spenders of all tourists. Visitation from residents of the United States is also significant.

There appears to be a trend in tourism towards shorter, more frequent trips, rather than lengthy, long distance vacations. There also appears be a trend towards educational and soft adventure vacations. Soft adventure vacations are defined as new experiences or adventures under relatively safe conditions. Public concern for the environment is fuelling an expanding ecotourism market.

The location of the Great Sand Hills, relatively close to Alberta, near major Saskatchewan urban centres and less than an hour drive north of the Trans-Canada Highway, combined with trends in the tourism industry suggests that tourism could be an important economic component of this region. The following section provides a partial list of the potential tourism assets of the Great Sand Hills.

Description of the Resource:

The landforms of the Great Sand Hills are the most obvious tourism resource. Large, active dunes already attract many visitors, offering them viewing and other recreational opportunities. Tourism use of this resource needs to be controlled to protect sensitive features and to prevent conflicts with other existing land uses. Provision of properly designed and managed recreational facilities is recommended to meet existing recreational demands and to control recreation use in the Great Sand Hills. Establishment of a relatively large undeveloped area is also recommended to provide opportunities for wilderness experiences, and to support development of cultural tourism activities such as trail rides or cattle round-ups.

The landforms of the Great Sand Hills are more than a recreational resource. They provide an excellent opportunity for research and education. The formation and evolution of the Great Sand Hills could form the basis for educational tours, catering to this growing segment of the tourism market.

Thus, there is a need to protect representative and unique portions of the Great Sand Hills through appropriate means.

The flora and fauna of the Great Sand Hills are already an important tourist resource. This is best understood in terms of hunting. However, the large game species and non-game wildlife attract wildlife viewers to the area. The economic value of this activity has not been determined. There is potential to market animal and plant viewing opportunities in the Great Sand Hills without significantly impacting these resources.

The Great Sand Hills are a valuable Saskatchewan heritage resource area. The archaeological resources of the Great Sand Hills have been studied and provide a fascinating prehistoric cultural overview of this area (see Section 3.6). These resources have enormous potential as educational and interpretive resources. Heritage resources have proven to be extremely successful tourist attractions throughout the world.

There is also potential to develop tourism around more recent heritage resources. Existing ranching operations exhibit part of Saskatchewan's settlement and development history. Ranching operations have proven to be successful tourist attractions in the United States. Ranchers in the Great Sand Hills may wish to explore the potential of developing ranching vacation packages to diversify their operations. Development of this resource could add to the regional economy as well as preserve and promote part of Saskatchewan's culture.

A developed infra-structure, (i.e., roads, signs, motels, hospitals, restaurants, etc)., is necessary to support tourism. Facilities near the Great Sand Hills, such as roads and motels have been developed to support industries such as gas development and hunting. These facilities can provide the foundation for tourism development in the Great Sand Hills. Further development should only occur after careful planning and market studies have been completed.

The museum in Sceptre appears to be drawing tourist to the village and probably stimulates visitation to the Great Sand Hills. Sceptre and other local communities are positioned to serve as a "Gate Ways" to the Great Sand Hills.

In summary, the resources of the Great Sand Hills and nearby communities can provide the foundation for a solid tourism industry. However, any development which may be proposed needs to recognize the sensitive nature of the Great Sand Hills and be compatible with local lifestyles. Increased awareness of the resources of the area will probably increase visitation. However, in order to maximize benefits and minimize impacts, tourism development must be well planned and coordinated. Therefore, preparation of a regional Tourism Development Plan is recommended. A development plan is required to undertake preliminary

marketing studies, reduce capital investment risks and anticipate infrastructure requirements. Effective tourism planning will require the participation of many individuals and organizations, as well as appropriate government agencies.

Specific Recommendations:

1. An advisory group should be formed to prepare a Tourism Development Plan. This group should be comprised of local citizens, interest groups and relevant government agencies.

2. The development plan should be completed prior to any facility development, tourism promotion or highway signage improvements.

3. Tourism development in the Great Sand Hills should only proceed when resources can be adequately protected, and when development is compatible with local life styles.

4. Non-consumptive use of the Great Sand Hills such as bird watching, hiking and heritage awareness programs should be emphasized.

5. Hunting should be maintained in the Great Sand Hills as an economic and recreational activity and to serve as a wildlife management tool.

6. Except for the possible development of day-use facilities in the Straw Road Area, tourism facility development should occur outside the Great Sand Hills.

7. Representative and unique landscapes of the Great Sand Hills should be protected through appropriate land use mechanisms such as zoning.

3.6 Archaeological Resources

Specific Objectives:

To protect the archaeological resources of the Great Sand Hills.

To ensure study and/or salvage of archaeological resources when protection is not feasible.

To encourage public awareness of the archaeological resources of the Great Sand Hills.

Description of the Resource:

The government agency responsible for archaeological resources, Heritage Resources-Archaeology (HRA), defines archaeological resources as "sites, structures, objects or other evidence of past human activity which can be used to reconstruct and explain past lifeways" (HRA 1989:17). The physical remains most often preserved include: tools and other occupational debris made of stone, clay, metal, bone and constructed features such as hearths, storage or

cooking pits, post holes, earthworks and wood or stone structures (HRA 1989:17).

Archaeological sites in Saskatchewan date from at least 11,500 Before Present (B.P.). They include a wide variety of types of remains including: camp or habitation sites, kill sites, burial sites, quarry and tool manufacturing sites, ceremonial sites and spiritual sites.

Archaeological sites are valuable resources as they have historical, ethnic, political, religious, social or other special symbolic or cultural values. They also have considerable potential as educational, scientific and tourism resources.

In the Great Sand Hills, archaeological features are the primary heritage resource of interest rather than those accompanying the built environment. Cultural components are very scarce in the Great Sand Hills for the Paleo-Indian and early historical periods, too rare to allow any generalizations with regard to their distribution. Epp and Townley-Smith (1980:113) report only two sites from the early historic period.

Site components from the Middle and Late Prehistoric Periods are much more numerous, permitting generalizations on site distribution between about 6,000 and 250 B.P. (Epp and Townley-Smith 1980:99). In general, site components show a gradual increase in numbers and frequency during the Middle Prehistoric Period when the dry and warm climates of the mid-Atlantic period prevailed. Sites are most frequent in the latter Middle Prehistoric Period and in the Late Prehistoric Period when the plains bison attained their great numbers.

Data from the Great Sand Hills (Epp and Townley-Smith 1980 *in* HRA 1989) illustrate the topographically related distribution of significant archaeological sites. Topographic variability provided shelter from the wind and made hunting much easier than in the surrounding plains (Epp 1983:193). Epp (1983:193) found a concentration of prehistoric sites in the periphery of the Great Sand Hills in comparison with the surrounding plains and the interior of the hills. Epp hypothesized that ecological variability associated with the plains/hills ecotone provided a wide and stable variety of food sources.

Epp (1983:191) indicates that two archaeological systematic surveys of the Great Sand Hills have provided fairly complete and representative data on site locations and type, permitting conclusions on site distributions and settlement patterns. Of 58 sites reported in Epp (op cit.), 45 are habitation sites and 13 are probably isolated artifact finds (e.g., materials lost during hunting expeditions).

Epp (1983:192) reports that there are three distinct site concentrations within the Great Sand Hills. Evidence of habitation is rare more than 7 km into the interior, although individual projectile points and small lithic scatters have been found in all parts of the Great Sand Hills. Epp (1983:195) indicates that

the distribution of known archaeological resources suggests that between about 2000 and 300 B.P., the occupants of the Great Sand Hills preferred to remain within gathering access distance of both the sand hills and the prairie environments, but that hunting forays frequently occurred much further afield into both areas. The fact that clusters of known sites are in the more northerly parts of the Great Sand Hills probably relates to the presence of bison. Presumably hunting was better for much of the year toward the South Saskatchewan River than away from the river.

HRA maintains detailed records of archaeological resources known to exist in the Great Sand Hills. Their record lists the occurrence of 266 archaeological sites in 25 townships including the entire Great Sand Hills. The vast majority of these locations are characterized as "artifact finds" or "artifact scatters" of very local distribution. Fewer finds are located over measurable geographic areas, on occasion a kilometre or longer. These finds are often in association with pipeline rights-of-way. The resource inventory lists five Sites of a Special Nature in the Great Sand Hills, including potential burial sites, a medicine wheel and a site classified as an alignment/ configuration. Only one of these sites is located within the moratorium area.

Field work revealed that sites in the Great Sand Hills are likely to include large communal bison kills, butchering and processing stations and base camps (HRA 1989:155). These sites may be spatially associated and contain multiple components. Other site types include transit and temporary camps, small-scale kills and bison monitoring locations. Human burials occur, but generally ceremonial or spiritual sites are rare.

A moderately high density of archaeological sites is expected in certain dune areas. Sites are concentrated in or near areas of maximal local relief, while the greater ecological diversity in peripheral areas of the Great Sand Hills increases site density there. Site visibility is variable, with wind action alternately exposing and burying sites.

Constraints and Opportunities:

Two characteristics of archaeological sites serve to emphasize the need to protect these resources. First, these sites are often inconspicuous and are therefore highly vulnerable to destruction from routine land disturbances. Second, archaeological sites are non-renewable resources, and once sites are destroyed, they cannot be recreated. The value of an archaeological site is dependant on its contents and its context. Thus, any significant disturbance greatly reduces the value of most archaeological resources.

Direct impacts to archaeological sites can occur due to land-modifying activities. Any site preparation or excavation can expose and result in the loss of exposed or shallowly buried artifacts. Intensive land use, such as occurs when cattle congregate at watering or feeding sites, can also damage surficial resources.

Direct impacts may be avoided in most instances by proper site evaluation and planning.

Many development activities enhance access into previously remote areas often resulting in an increase in the number of people in an area. This will not cause direct impacts on heritage resources, but creates the potential for significant indirect impacts. Visitors who have no direct interest in archaeological or vertebrate paleontological resources, may collect or otherwise disturb resources if presented with the opportunity. Over time, potential impacts of this sort can have greater adverse impacts on heritage sites than the more rapid and immediate, but frequently more easily controlled, direct impacts. Indirect impacts are also often more difficult to assess and quantify (HRA 1989:22, 23).

The heritage resources of the Great Sand Hills could be used for interpretive activities. This could create opportunities for increased tourism with attendant economic benefits for the local communities and help protect heritage resources through increased public awareness and understanding.

Much of the archaeological research undertaken in Saskatchewan today is associated with specific development projects. The increase in development in the Great Sand Hills in recent years has created the need and the opportunity for substantial additional archaeological research, primarily of specific development sites. Large-scale development activities have resulted in the location and salvage of numerous heritage sites. Hence, development in an area creates the opportunity for archaeological investigations in the Great Sand Hills.

Management Practices and Guidelines:

The main legislation for protection of heritage resources in Saskatchewan is *The Heritage Property Act*. The Heritage Branch is responsible for administering *The Act* which allows Provincial Government agencies to undertake the following key activities:

1. Require impact assessment studies or other actions of developers whose projects may adversely affect heritage property.

2. Issue temporary stop orders to cease an activity which is likely to result in damage or destruction of heritage property.

3. Issue permits which authorize heritage site investigations.

4. Designate provincially significant heritage property, thereby exercising certain controls over the use and development of land.

5. Prohibit the unauthorized removal of archaeological material from a site.

The Heritage Property Act singles out specific site types, such as human burials and burial places, rock art sites (pictographs, petroglyphs) and boulder monuments (medicine wheels, effigies and vision quest structures), affording them explicit protection from alteration. The Act also provides for Crown ownership of all archaeological and vertebrate paleontological objects found in Saskatchewan, and prohibits their unauthorized sale or removal from Saskatchewan.

Since 1980, heritage resources increasingly have been considered as part of the environmental impact assessment (EIA) process, especially for larger scale projects. Land use and development proposals are reviewed routinely by Heritage Branch to determine the need for and level of heritage resource impact assessment, salvage excavation or other conservation measures. By ensuring that project related impacts are prevented, reduced or otherwise managed, the heritage review complements Saskatchewan's EIA process.

Two levels of impact investigation are undertaken.

Overview assessments identify and evaluate the resource potential and define appropriate methods and scope for any follow-up study. Use of existing information is emphasized, although some field work may be included.

Detailed assessments provide comprehensive information and alternative recommendations for managing impacts, based primarily on site surveys and evaluations, and are a principal means of determining what mitigative actions may be required.

Impact Management follows from assessment, and is concerned with minimizing unavoidable and unanticipated impacts before construction. Mitigation measures include changes in project design or location, site protection measures and systematic data recovery. Avoidance is the preferred option and may include measures such as site burial, stabilization and use of physical barriers such as fences.

Where project actions inadvertently uncover a significant heritage site, documentation of the deposits and emergency salvage may be required. This may require a temporary interruption or relocation of construction.

All heritage resource impact assessments and management studies must be carried out by qualified personnel under a permit issued by responsible government agencies. Each study must be designed to meet specific project characteristics and needs.

Specific Recommendations:

1. Developers should refer all land use and development proposals for the Great Sand Hills to Heritage Branch for review as early in the development-planning process as possible.

2. The existing procedure whereby Heritage Branch participates in project screening and reviews under the Environmental Impact Assessment process coordinated by SEPS should be continued.

3. Development activities associated with existing land-uses such as dugout or other local excavation, building or corral construction or new trail development should be referred to Heritage Branch for screening before initiating construction. Where provincial Crown lands are involved, Rural Development should assist lessees with these referrals.

4. Promoters or facilitators of any tourism ventures involving public access into the Great Sand Hills should be fully apprised of the regulations concerning artifact collection, excavation or other disturbance of heritage resources. An information package on heritage resources and the legal prohibitions on site disturbance and collection should be made available to hunters and other visitors to the area.

5. Any tourist trails or other similar facilities should avoid sites of high heritage resource value or potential, except where these sites are part of a formal and carefully controlled interpretative program.

3.7 Groundwater Resources

Specific Management Objectives:

To preserve the quality of groundwater resources in the Great Sand Hills.

To ensure availability of shallow groundwater resources for human domestic use, and use by livestock and wildlife.

To use groundwater as a tool for management of the rangeland resource.

Description of the Resource:

Golder Associates (Golder 1987) describe four potential aquifers underlying the Great Sand Hills area. These are: an upper intertill aquifer; a lower intertill aquifer; the Johnsborough Valley, a drift-filled, pre-glacial bedrock valley aquifer; and, the Judith River formation, a bedrock aquifer.

Upper Intertill. This upper silty sand and till unit normally occurs within 25 m of the surface and is overlain with 6 to 12 m of aeolian sand. The upper intertill averages 5 m in thickness, although near Bigstick Lake it increases to up to 25 m thick (Golder 1987). Sand lenses are interbedded with till, limiting thickness

of permeable materials. This interbedding, plus the variable composition of the unit across the sand hills area, severely limits reliability of the aquifer as a groundwater source. Water yields average about 0.3 litres per second (L/s) (Golder 1987).

The depth at which the upper intertill occurs is dependent on the thickness of the loose, overlying sand. Water is typically found in the more compact, much less permeable underlying till or glacio-lacustrine material. Where this layer is sufficiently close to the surface, sufficient water can be tapped to support trees and small shrubs and to provide a stable water supply for dugouts and shallow wells (NCO 1990).

The upper intertill aquifer occurs at the ground surface near Bigstick Lake. It is also known to outcrop in at least two other locations, in Township 20, Range 22 and Township 16, Range 22, West of 3. Golder (1987) mapped this aquifer as underlying virtually the entire Great Sand Hills, with the exception of the area around Crane Lake.

Lower Intertill. This unit occurs about 15 to 100 m below surface, but most commonly is found between 17 and 37 m (Golder 1987). Water-bearing materials are composed of sand and silty sand, usually in bands 5 to 7 m thick, and are interbedded with till. Water yields are variable. The range reported by Golder (1987) was 0.4 to 1.5 L/s, although higher yields may be expected where the intertill sands are thicker. A single estimate of potential well yield by Golder (1987) based on one observation well, was in the order of 0.15 to 2.3 L/s. The water is of the calcium magnesium sulphate type.

The Lower Intertill aquifer underlies the entire Great Sand Hills except for the southwestern area around Crane and Bigstick Lakes. It narrows considerably in the vicinity of Township 18, excluding a portion of the east side of the Great Sand Hills at that latitude (Golder 1987).

Johnsborough Valley. Glacial and pre-glacial processes have eroded two major bedrock valleys in the vicinity of the Great Sand Hills. The Johnsborough Valley extends north from the Bigstick Lake area to join the Tyner Valley near Prelate. The Johnsborough Valley, a bedrock valley aquifer, occurs predominantly in the northern part of the Great Sand Hills, north of the approximate latitude of Freefight Lake. The R.M. of Clinworth has completed a well in this aquifer producing at a rate of 7.6 L/s.

The valley contains interbedded water-bearing sand and silty sand layers which typically yield water at rates of 3.8 to 4.5 L/s. The only exploration well into this aquifer is near Prelate, and it encountered the aquifer between depths of 53.1 and 127.5 m. A single estimate of potential well yield by Golder (1987) based on one observation well, was in the order of 34 L/s. These waters are of the sodium sulphate type, and may exceed guidelines for human consumption (Golder 1987).

Judith River. This bedrock valley formation which occurs at depths of 100 to 160 m, is typically 5 to 50 m thick, and subcrops along the bedrock Johnsborough and Tyner Valleys. Its interbedded marine sandstones and siltstones are part of the Judith River formation, and yield water at rates of 0.4 to 1.1 L/s (Golder 1987). Water is of the sodium, magnesium, calcium sulphate, bicarbonate type, and Total Dissolved Solids (TDS) reportedly range between 565 and 3,690 ppm (David and Whitaker 1973 in NCO 1990).

The Judith River aquifer underlies the entire Great Sand Hills except for a small area south and west of Crane Lake. The composition of the aquifer varies considerable in terms of thickness and number of sandstone beds, affecting potential well yields (Golder 1987).

Most of the shallow wells and dugouts in the sand hills area are developed in the shallow Intertill aquifer and satisfy one of the key requirements for raising livestock in this area. Most wells are completed in sand-gravel lenses at depths of 5 to 106 m. Water is raised using windmills, electrically powered pumps and a small number of solar powered pumps. Water levels in wells and dugouts fluctuate somewhat depending on regional precipitation.

Limited use has been made of the deeper Johnsborough and Judith River groundwater formations. Lone Pine Resources has used some deep groundwater for drilling.

Golder (1987) included a limited testhole program in their study of groundwater in the Great Sand Hills, and identified only one location where potential well yields were estimated to be sufficient to support individual irrigation supply systems. The test location contained water of a sodium sulphate type which may not be suitable for irrigation purposes.

Constraints and Opportunities:

Constraints associated with groundwater in the Great Sand Hills include: production capability, distribution of wells and dugouts, intrinsic quality (from certain aquifers) and susceptibility of the shallow aquifers to contamination from surface activities. Cross-contamination between aquifers along wellbores has been raised as a potential groundwater problem.

Production capability of the aquifers varies considerably. In only one instance was a potential production rate in excess of the required minimum for an individual, small scale irrigation project (10 L/s for the mid-May to mid-August growing season) (Golder 1987). This test hole was in the Prelate area, and while it yielded water which met irrigation quality guidelines, it nonetheless raised doubts as to the overall acceptability for irrigation of water in that aquifer. Additional investigation is required before any serious, large scale irrigation proposal could be contemplated.

At present, water wells and dugouts are not distributed uniformly over the Great Sand Hills. The distribution and density of livestock watering facilities have depended on the watering needs as identified by the pasture manager or lessee, on the ability of the livestock operation to support the costs of extra infrastructural development and on the availability of subsidies for well and dugout construction. The ability to manipulate grazing pressure on a relatively small scale is dependant to a substantial extent on the availability of reliable water supplies in individual pasture units.

Potential water uses are limited by the quality of the water and treatment cost. Water from the Belly River formation (a deep bedrock aquifer) has been used for drilling fluid makeup water to alleviate demands on higher quality, shallower waters which are in demand for domestic and livestock use. The quality of the Belly River water renders it unacceptable for domestic or livestock use.

Porous, surficial sands render shallow aquifers susceptible to contamination from sources such as spills of industrial chemicals, fuels and herbicides, and from bacteria, nitrates or other materials from livestock operations. Industrial development in the Great Sand Hills area to date has not involved large quantities of toxic chemicals. Drilling fluids have involved primarily materials commonly used as fertilizers which pose little threat to groundwater if handled carefully. Numerous precautions have been implemented to ensure that fuel spills do not occur. Similarly, steel tanks are required to contain drilling and fracturing fluids used during gas well development. Both drilling wastes and brine co-produced with the natural gas are managed and disposed of according to strict guidelines.

Concern has been expressed regarding inter-aquifer contamination along well bores and as a result of lost circulation of drilling fluids and subsequent escape of these materials into the shallow groundwater. Testing of shallow groundwater accompanies drilling where there is shallow ground water or where water wells or dugouts are located near gas wells.

The primary economic use for groundwater in the area at present is by the ranching industry. One of the factors limiting effective distribution of grazing pressure is limited water availability in certain areas. Additional infrastructural development is possible given appropriate funding and planning.

Current practices for natural gas development have been developed to ensure that shallow and deeper groundwater resources are protected from all phases of the development activity. To date, there have been no known instances where spills or leaks of drilling materials; fuels or produced brines have caused other than very local contamination of shallow groundwater.

Natural gas development in the Great Sand Hills creates opportunities for development of groundwater. If gas wells are drilled and subsequently proven not to be economic producers of gas, it may be possible to re-complete the well in such a manner that it can continue to serve as a water well. This approach has received limited application to date as only a few gas wells drilled in the sand hills have not been economic producers. The procedure requires additional testing to demonstrate its efficacy and economic feasibility.

Certain drilling programs have used shallow groundwater for drilling fluid makeup. Such water use has required construction of new, or enhancement of existing dugouts in areas where surface water availability has been a constraint to effective range management. Similarly, there has been at least one case where a water well was drilled on a gas lease site to provide water for drilling. This well was subsequently used to irrigate the lease site as part of a highly successful reclamation program. Properly located and managed, such new dugouts and wells can have beneficial effects on range management with no deleterious effects on water quality or quantity.

Brines produced with the gas can have beneficial uses in this water-short area. The produced brines have relatively low concentrations of salts, some 6,000 to 12,000 ppm TDS, primarily sodium chloride. These brines are currently either produced at the wellsite or flow-lined to a central facility where the primary disposal option is evaporation. Hauling wastes to either disposal wells or to approved alkali sloughs for dumping is also practised. Technology, currently in the experimental stage, may make it feasible to purify produced water so that it can be recycled or used for reclamation.

Management Practices and Guidelines:

Groundwater use in Saskatchewan is regulated by *The Groundwater Conservation Act* and Regulations under that Act. The Act does not apply to wells drilled by landowners on their land, using their own equipment to obtain water for domestic use. Any industrial use of water, however, requires permission from the Saskatchewan Water Corporation. Aside from the above, and except for domestic water use, no person may undertake a groundwater investigation program, drill a water well or use groundwater without first obtaining the necessary permit(s).

Oil and gas drilling is done in accordance with stringent regulations under *The Oil and Gas Conservation Act* to protect groundwater resources. Protective measures include: setting of surface casing through groundwater, cementing drilled wells to the surface, use of blow-out prevention equipment to control the escape of gas or oil, and setting and cementing of production casing through porous horizons. Upon abandonment of the well, cement plugs are placed in the well to prevent migration of gas or any fluids to any other zones or to the potable water zone.

Groundwater protection is also important in the handling of drilling fluids. In the Great Sand Hills, mud tanks are required rather than conventional mud pits. This eliminates the possibility of contamination of the high groundwater table and reduces surface disturbance.

Specific Recommendations:

1. The current system of managing industrial uses of groundwater in the Great Sand Hills should be maintained. The Saskatchewan Water Corporation should review all proposed industrial uses of groundwater to reduce potential conflicts between all water users, including wildlife.

2. Water quality should be sampled by gas developers in all dugouts and water wells within 250 meters of all gas wells and within 1000 meters of all brine disposal or evaporation facilities prior to initiation of drilling or construction. Environment and Public Safety should require water quality sampling within a larger radius of proposed developments when warranted. Baseline data should be reported in the project proposal or environmental impact statement prepared for the project.

3. Drill cuttings and sump fluid solids should be buried on lease only if they are covered by a minimum of two meters of low permeability material and only if the groundwater level is at least two meters below the base of the pit. Ammonium sulphate solids should be dried on surface and mixed with native soil materials prior to burying.

4. Water supply and distribution should be used more fully as a range management tool. New wells and dugouts should be part of comprehensive range management and planning undertaken by ranchers in cooperation with range management specialists.

5. Any water wells or dugouts constructed by the gas industry to supply water for drilling fluid make-up or irrigation should be located in cooperation with the land owner/occupant. When abandoned, these facilities should be made available to livestock operators.

6. In order to prevent groundwater contamination, direct livestock access to new dugouts should not be allowed and should be phased out as improvements or renovations are made at existing locations. Water should be pumped into tanks near the dugout. Solar powered pumps are recommended as environmentally and aesthetically preferable to conventionally powered pumps.

7. Limited, short term use should be made of available shallow groundwater for irrigation of wellsites and rights-of-way as part of reclamation efforts, particularly in locations which are difficult to reclaim.

8. The use of purified, produced water for reclamation of disturbed locations should be encouraged.

9. Industrial water developments (e.g., water wells, pipelines, irrigation projects) in the Great Sand Hills should be subject to the environmental impact assessment process.

3.8 Utility Corridors

Specific Management Objectives:

To ensure protection of the sensitive and unique features of the Great Sand Hills during construction and operation of utility corridors and associated facilities.

Description of the Existing Situation:

Several major east-west transportation corridors currently cross the Great Sand Hills. Numerous roads, pipelines and electrical transmission and telephone lines also enter into the Great Sand Hills to provide services either to area residents, or for natural gas, ranching or other industrial uses. A variety of pipelines also serve to gather produced natural gas and transport it to compressor stations located on the periphery of the Great Sand Hills.

The only roads in the Great Sand Hills are grid or farm access roads. There are also a variety of unimproved trails, developed and maintained by ranchers and natural gas development companies. A total inventory of these trails has not been conducted; however, recent high altitude aerial photography indicates an extensive trail network exists (Mollard 1990). The recent proliferation of gas development in certain areas of the Great Sand Hills has contributed to the extensive trail network, although many of the additions are narrow trails which terminate at individual wellsites. Gas development companies are required to use existing trails wherever feasible.

The only east-west road link crossing the Great Sand Hills is the "Millie Road". It originates at 20-16-21-3 west of Hazlet and traverses a relatively low sensitivity area of the Great Sand Hills. It rejoins the regular road network at 25-16-23-3 east of Ingebrigt Lake. The road provides dry weather access. It is maintained with minimal inputs, besides periodic grading. Some sections of the road have been incised into the sand by a combination of long term use and wind erosion. Various roads and trails provide access to residences within the Great Sand Hills. The Straw Road provides access to the open dunes in the Straw Road area in the northwestern corner of the Great Sand Hills.

Roads are maintained by a combination of efforts involving R.M.s and ranchers. Many of these trails cause minimal direct impact to the resources of the Great Sand Hills, but others have been subject

to severe erosion and have become deep, permanent scars on the landscape. There has been a tendency for traffic to move "off right-of-way" when an existing trail becomes difficult to use. This has caused expansion and migration of the problem to adjacent areas.

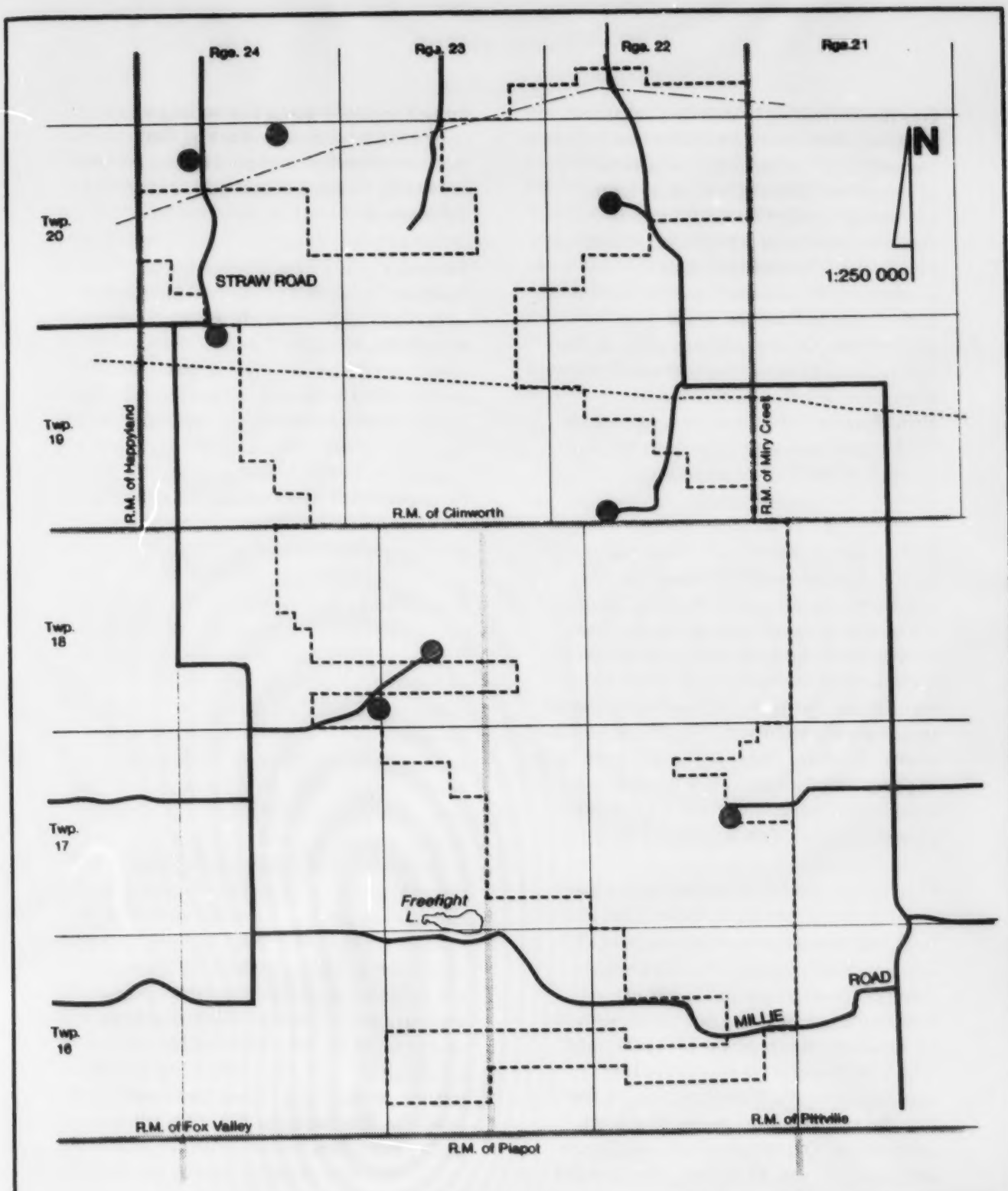
Trail development and use by gas development companies in the Great Sand Hills area has rarely resulted in major erosion problems. A variety of techniques are used to stabilize trails and to repair them as and when required.

Two major pipelines cross portions of the Great Sand Hills: the TransCanada PipeLines (TCPL) facility in the northern part of the area and the Foothills/NOVA line which traverses the southwestern corner (see Map 8).

The TCPL line follows a straight right-of-way crossing the Great Sand Hills at about the latitude of Liebenthal. It consists of one large oil line and five large gas lines in one right-of-way. The fifth gas line was recently installed. This line will occupy the last available space within TCPL's current easement.

A much smaller diameter pipeline operated by Petro-Canada parallels the TCPL lines. Considerable disturbance resulted during emplacement of this and the TCPL lines. This has left a straight, relatively level strip of altered vegetation which is readily visible both from the ground and from the air. Substantial effort has been expended by TCPL in restabilizing and revegetating the major disturbances accompanying these projects. While the right-of-way can be considered stabilized, it has not been successfully reclaimed. Rehabilitation to a self sustaining native vegetation community will require many years.

Another pipeline, the Alaska Highway Gas Pipeline, crosses the southern periphery of the southern block of the Great Sand Hills. The line was constructed by Foothills Pipe Lines and is now owned by NOVA, AN ALBERTA CORPORATION but is operated by TCPL. The line which passes to the south and southwest of Bigstick and Crane Lakes, was the subject of extensive research into methods for stabilizing and revegetating sandy soils (Walker et al. 1986, Walker 1987). This research continues to form a basis for reclamation practices and policies in the Great Sand Hills and similar areas. Long term environmental implications of this line have been reduced due to the smaller size of the line, the single disturbance the area received and the relatively less sensitive nature of southern portion of the sand hills.



GREAT *SAND* HILLS

Integrated Land Use Plan

ROAD
GAS PIPELINE
RANCH
POWERLINE

LANDUSE 8

Gas development to date in peripheral areas of the Great Sand Hills has necessitated construction of a network of pipelines. These lines range from gathering lines of about 90 mm in diameter, many of which are plowed in, to 420 mm lines which carry all production from Lone Pine Resources' and Ocelot Industries' wells to a compressor on the western edge of the Great Sand Hills. The gathering systems have been sized to accommodate anticipated production from future gas field expansion, and thus have been located in relation to overall development plans.

Reducing terrain impacts is a major factor in planning and developing pipeline networks. Detailed planning and initial over-capacity construction has been undertaken by some companies at considerable cost to ensure that significant disturbance that accompanies major pipeline construction is a one time event. To date, reclamation of these lines appears to be attainable with the innovative techniques that have been pioneered in this area.

One major electrical transmission line crosses the Great Sand Hills. This is the Saskatchewan Power Corporation (SPC) 230 kV, Swift Current to Empress, Alberta intertie line (SPC 1987). Construction of this line was subject to an Environmental Impact Assessment. The line traverses a relatively low sensitivity route. Construction of the line did not result in major problems with respect to reclamation, wildlife or increased access. However, the line did impact visually upon the rolling landscape of the area. Part of the transmission line's route crosses an area currently under natural gas development.

Several types of small scale linear features exist, the primary functions of which are to provide electricity and telephone services. These lines were placed above ground in the past, but more recently have been buried, usually using plow-in techniques. In addition to electrical service to ranch yards, above and below ground electrical service has been provided to a number of water wells and dugouts to modernize stock watering operations.

Constraints and Opportunities:

The primary constraints to development of linear transportation corridors in the Great Sand Hills relate to the general environmental sensitivity of the entire area, and to the extreme environmental sensitivity of substantial portions of the area. Environmental sensitivity creates challenges associated with routing, reclamation and public perception. Several of these constraints, particularly the cost of associated environmental studies and of long term reclamation and monitoring, can substantially increase the costs of projects. Similarly, public concern may require substantial time and resources devoted to public information and education. The sensitive nature of the Great Sand Hills will likely result in the need for EIA's for all major utility corridors.

The single, largest linear project constructed in the Great Sand Hills to date, the TCPL line, has experienced substantial problems during the 35 years since the project was initiated. Although this project may be a worst case example (repeated major disturbances in a confined, high sensitivity right-of-way, with much of the work done before modern reclamation techniques were developed), it demonstrates the constraints imposed by climate and terrain features of the Great Sand Hills area.

Aside from the constraints associated with a highly sensitive, sandy environment, construction in the Great Sand Hills is in some ways relatively easy. There are no large rocks or areas of exposed bedrock, no wetlands, no heavily forested areas. If acceptable routings can be located, and if planning and development mitigation measures can resolve both public concerns and minimize long term reclamation problems, then construction of utility corridors may be feasible.

Management Practices and Guidelines:

The principal planning and approval process for major projects at the provincial level is the environmental impact assessment process. Following any approval pursuant to *The Environmental Assessment Act*, other approvals pursuant to land adminstration, wildlife protection, heritage resource protection and similar provincial statutes would follow, in addition to whatever approvals are required under rural municipal zoning and development control bylaws. In the case of energy related linear facilities which are either interprovincial or international in scope, the procedures and approval processes administered by the federal National Energy Board will apply. In this case, most provincial and municipal law is not applicable.

Specific Recommendations:

1. All proposed corridor projects should undergo environmental screening and review. This recommendation applies to construction, upgrading or expansion to facilities such as: graded roads, pipelines, transmission lines and domestic electricity, telephone or natural gas distribution lines. Non-graded trails used by ranchers for range management purposes should be exempt from this review process.

2. Any future expansion of the TransCanada PipeLine system should be subject to comprehensive environmental examination, including public meetings.

3. TransCanada PipeLine should identify their future corridor requirements and provide assistance in determining other uses or conditions of use for this corridor.

4. Any proposals for gas, water supply or similar development for which a major linear facility would be required (e.g., trunk pipeline, major

service road) should require that ancillary pipelines, roads or similar features be included as part of the proposal that is reviewed for environmental implications.

5. The existing trail network in the Great Sand Hills should be examined by appropriate individuals, corporations and government agencies to identify and reclaim sites where roads or other linear features have caused significant scarring of the landscape or have created situations where future environmental damage may result.

6. The responsible parties (R.M.s and/or Highways and Transportation) should take a stronger and more proactive role in ensuring that undeveloped road allowances are accorded a greater degree of protection. Use of these road allowances for access by resource companies, including seismic exploration companies, and by the public (including lessees of adjacent land) should be subject to greater review, and be subject to the same environmental protection and restoration requirements as apply on adjacent lands.

7. Any new or replacement phone and small scale electrical transmission lines should be plowed in.

8. The reclamation standards provided in Section 3.9 of this report should be used to evaluate reclamation success following construction of utility corridors.

3.9 Reclamation

Reclamation is the process of restoring a disturbed site to a desired condition within a specified period of time. The ultimate goal of reclamation in a natural area such as the Great Sand Hills, is recovery of disturbed sites to self sustaining, native plant communities.

Surface disturbances in portions of the Great Sand Hills have resulted from many activities, including gas development, pipeline construction, livestock production, recreational traffic and other land uses. Low annual precipitation in combination with the sandy soils of the Great Sand Hills makes reclamation difficult. The area is also a high wind erosion zone which further complicates reclamation.

Protection of the Great Sand Hills requires setting reclamation objectives and stringent standards that must be met by all land users. Specific reclamation techniques for the Great Sand Hills have been developed based on previous reclamation experience in the Great Sand Hills and similar areas. These are available in the various Environmental Protection Plans and Environmental Impact Assessments

submitted by the gas developers as well as reports such as Walker et al. (1986), Saskatchewan Environment (1987) and TransCanada PipeLines Ltd. (1990).

The following reclamation objectives and standards should be used to measure reclamation success in the Great Sand Hills. They are provided primarily to guide reclamation that is associated with gas development. However, the objectives and standards should be applied to agricultural and other development in the Great Sand Hills.

Reclamation Objectives

1. Short Term Objective (1 to 2 years)
   Stabilize soil in and surrounding disturbed areas that result from development to prevent soil loss.

2. Mid Term Objective (3 to 5 years)
   Restore stabilized areas to states resembling as closely as possible pre-disturbance conditions in terms of species composition, rangeland productivity and physical appearance.

3. Long Term Objective (greater than 5 years)
   Allow natural successional processes to occur in reclaimed areas, with the areas eventually returning to a state indistinguishable from the pre-disturbance condition.

Reclamation Standards:

Successful reclamation requires that reclamation be considered as an integral part of overall development planning. Reclamation standards are provided to ensure that developers understand their obligations prior to initiating development. Standards also allow developers to evaluate reclamation feasibility and to determine their reclamation costs as part of project feasibility planning.

All project proposals and environmental impact assessments will be required to include detailed information on reclamation planning which should be incorporated into the overall project plan. Proposals and assessments will be required to demonstrate that plans and commitments are feasible, and that developers have the necessary financial and technical resources available to accomplish reclamation commitments.

Following completion of any development, the developer will be required to submit an annual reclamation report to Environment and Public Safety and to Rural Development. An annual report will be required for a minimum of five years from the date of development. Five years is considered to be the minimum period necessary to determine reclamation success. When reclamation success has been achieved, developers will be relieved of future reclamation responsibility for that

location. This does not affect the developer's responsibility for decommissioning as may be required under other legislation for specific types of developments (e.g., well decommissioning under *The Oil and Gas Conservation Act*). Requirements under any future reclamation regulations should be integrated into the procedures outlined in this section.

The components of the annual reclamation report are described under the various standards outlined below. Evaluations of reclamation success must be conducted by qualified personnel using accepted scientific procedures.

Erosion Standard. Development sites should be inspected regularly to identify actively eroding sites. These inspections should be made at least annually in stabilized sites, but more frequent inspections will be required in unstable locations. Rapid soil loss, normally by wind, must be prevented to avoid loss of seeds, plant propagation material and fertile soils. Indicators of active soil erosion include soil deposition offsite, soil pedestals, erosion pavement and wind scours (TCPL 1990:36). Sites that are eroding should be stabilized with appropriate measures and reseeded or otherwise revegetated.

The annual report should detail erosion control successes and failures, and should specify any additional remedial measures that may be necessary. Dates of inspections and future remedial work should be provided in the annual reclamation report.

Soil Standard. Achievement of a self-sustaining native plant community will require the re-establishment of soil quality to pre-disturbance conditions at disturbed sites. The primary parameters for identifying the progress of soil reconstruction are soil organic matter and soil nutrients, especially nitrogen, phosphorus, potassium, magnesium, sulphur and calcium. The amount of organic matter present is an indicator of the soil's susceptibility to erosion and its moisture holding capability. Both are key factors in promoting future plant growth (TCPL 1990:37).

For soil reclamation to be considered successful, disturbed sites must have a soil nutrient and organic matter content within 10% of adjacent undisturbed sites of similar soil type. Developers must submit the results of paired sample nutrient and total organic matter tests with their fifth-year reclamation report. If the standard is not achieved, additional remediation such as reseeding, fertilization, mulching and establishment of nitrogen-fixing plants will be required.

Revegetation Standard. Revegetation is a central component of reclamation success. Revegetation success will be measured in terms of plant density and species composition. Establishment of rangeland grasses normally takes two to five years, depending on species and prevailing weather conditions (TCPL 1990:37).

Revegetation will be considered successful if disturbed sites are reclaimed to the following standards:

- a minimum pasture grass/legume density of 10 plants per square meter distributed over at least 90% of the disturbed area; and

- an average plant canopy of at least 45%.

Developers will be required to evaluate reclamation success three years after the last inputs of reclamation (e.g., fertilizer, seeding, etc.). Sites that do not meet the above criteria will require additional inputs, such as fertilizer, other soil amendments and reseeding. Following such additional inputs, the site should be re-evaluated every three years or more frequently until the standard is achieved.

Plant Community Standard. As previously stated, the desired result of reclamation is that disturbed sites recover to self sustaining native plant communities. The plant community reclamation standard is as follows: after five years from the last inputs of revegetation, at least 50% of the vegetation on reclaimed sites is to be native plants. If this standard is not achieved, the site should be reseeded and native shrubs and forbs should be transplanted to the site.

Seed Mix

While the desired end result of reclamation is a community of native vegetation, the use of native plant seeds is not always feasible or the most effective means of stabilizing disturbed sites.

Based on previous experience in the Great Sand Hills, a mixture of native and non-aggressive, non-native seeds is recommended. Non-native plants such as Hard Fescue (*Festuca ovina duriuscula*) are recommended for their desirable reclamation characteristics, such as the ability to grow in infertile soils, drought tolerance, and winter hardiness. Other species useful for this application include fall and spring rye, winter and spring wheat, barley, alfalfa and sainfoin. Safflower has received some experimental application. By choosing these relatively non-aggressive, non-native species, eventually native species should dominate disturbed sites.

A mix of plant seeds is recommended to reduce plant community susceptibility to establishment failure, excessive grazing pressure and disease. A list of recommended reclamation plant species is provided in Appendix A.

Developers may use alternate seed species for reclamation with approval from Environment and Public Safety. All reclamation proposals, including seed mixes, should be specified in detail in the project proposal or Environmental Impact Statement. Variations from the recommended seed mix should be accompanied by detailed explanations of how the proposed mix meets the established objectives. The same

reclamation standards will be applied to measure reclamation success, irrespective of the seed mix used.

Specific Recommendations:

1. All developers should evaluate success of reclamation projects at least annually. Annual reclamation reports should be filed with Environment and Public Safety and Rural Development.

2. Developers should ensure that annual reclamation evaluations are conducted by qualified personnel, according to accepted scientific techniques. Reclamation reports should include the qualifications of personnel undertaking the field work.

3. Provincial Government agencies including Environment and Public Safety, Energy and Mines, Rural Development and other departments as may be appropriate should inspect development sites at least annually to ensure that procedures and standards established in this plan and in EPPs and EISs are being followed or achieved. These inspections should continue until site reclamation has been completed satisfactorily.

4. Environment and Public Safety should issue a certificate of reclamation to developers when reclamation programs achieve the various standards outlined in this section. This certificate, which should normally be issued only after at least five years of revegetation, should absolve the developer of all future surface reclamation requirements, except at any sites redisturbed by the developer. Other decommissioning and abandonment requirements would continue to apply where specific requirements exist.

5. A system of bonding or its equivalent should be developed to ensure that developers have the necessary financial resources to achieve successful reclamation.

3.10 Vehicle Access

Specific Objective:

To provide efficient and effective vehicle access routes for approved land uses without significantly impacting the biological, physical, cultural and aesthetic resources of the Great Sand Hills.

Current Access:

As previously discussed in the utility corridor section of this plan, the only roads in the Great Sand Hills are grid or farm access roads. The only major roads in the Great Sand Hills are the Millie Road and the Straw Road. There is also a variety of unimproved trails, developed and maintained by ranchers and natural gas development companies. Recent high-altitude aerial photography has shown that an extensive trail network

system exists throughout much of the Great Sand Hills including the moratorium area (Mollard 1990).

Roads and trails are necessary to support various land uses in the Great Sand Hills. Ranchers need access to their livestock and water facilities; gas development companies require access for exploration and development; and a trail system is necessary to distribute hunters. The Straw Road currently provides tourist access to a portion of the Great Sand Hills.

Access Issues:

The Land Use Planning Committee found substantial public concern regarding vehicle access in the Great Sand Hills. The key issues were: increased vehicle use could have a negative impact upon native plants and animals, especially through increased hunting pressure; significant soil erosion could result from vehicle traffic disturbing stabilized areas; and vehicles and trails would negatively impact upon the natural scenery of the Great Sand Hills.

Management Practices:

Grazing by livestock and wildlife could be negatively impacted as vegetation is lost to road development. Agricultural lease holders are allowed to develop trails they feel are necessary to support their operations. It is in the best interest of ranchers to minimize development which reduces the amount of vegetation available to their livestock. Agriculture lessees should work with, and seek approval from Rural Development and the Wildlife Branch of Parks and Renewable Resources prior to any road or trail development.

Much of the concern about increased road development and vehicle traffic stems from recent gas development in the Great Sand Hills. Exploration and development of gas has contributed to the existing trail network. However, airphoto interpretation has shown that a maze of trails existed prior to any gas development. Use of existing trails and construction of new trails for gas development must be specified through Environmental Protection Plans and Environmental Impact Assessments. It is recommended that this system be retained, and that access approval receive review from Rural Development and Parks and Renewable Resources. Where possible, developers should utilize existing trails. Where new trails are necessary, developers must proceed with the understanding that they are responsible for complete reclamation, unless otherwise specified.

Wildlife in the Great Sand Hills could be impacted by increased vehicle traffic and road development. Animals can be affected directly through vehicle caused deaths or indirectly through disturbance especially during breeding periods or in critical "wintering areas". Improved vehicle access could also impact game species as hunting pressure in remote areas could be increased. The impacts of new trails on game species are not easy

to predict, however, previous experience suggests that road development is a major factor in population management.

Hunters have access to the Great Sand Hills upon receiving permission from agriculture lease holders. They are asked to travel on existing trails while hunting, but may travel off trail to retrieve killed animals. Currently, there are no designated hunting trails in the Great Sand Hills. Roads and trails should be closed to vehicle traffic if it is necessary to protect wildlife from disturbances during critical periods.

Increased trail development is also a concern from an aesthetic perspective. The aesthetic impact of trail development is probably the most difficult issue to manage given the extensive trail network that already exists, and the need for additional trails for gas and other developments. Establishment of Prime Protection Areas will provide opportunities for wilderness experiences, including escape from vehicles.

Reclamation standards have also been provided in this plan to help reduce aesthetic or visual impacts resulting from development. With effective reclamation, the scars of development including roads and trails can be eliminated over time. This will help to maintain the aesthetic value of the Great Sand Hills.

Specific Recommendations:

1. Road and trail development in the Great Sand Hills should be minimized.

2. All developers, (gas, agricultural, R.M.s, etc.) should obtain approval from appropriate regulatory agencies prior to any road or trail development.

3. Developers should be responsible for reclamation of new roads and trails they create.

4. Trail development should be minimized in Prime Protection Areas.

5. Any new roads or trails should minimize impacts to landforms and archaeological resources.

4. Implementation

Specific Objectives:

To ensure that the goals, objectives and policies articulated in this land use strategy are properly and adequately addressed.

To ensure that strategy implementation involves a commitment to consultation and coordination among affected provincial agencies, municipal governments, advocacy groups, residents and land users.

Provincial Mandate:

Four provincial government departments with significant interests relating to the Great Sand Hills (Energy and Mines, Environment and Public Safety, Parks and Renewable Resources and Rural Development), have signalled their commitment to coordinated land use management in the area through their active participation in this study. This commitment should extend to the implementation of any applicable strategy provisions, and would be further legitimized by their adoption of the strategy as departmental policy.

Although not directly involved in the current land use study, other provincial departments have interests and responsibilities with respect to certain existing and potential activities in the Great Sand Hills. It is anticipated that these departments will exercise their respective mandates in consultation with other affected agencies and individuals, with due regard for the relevant provisions of this strategy.

It is noted that each department currently operates in its own regulatory environment. This strategy will not supersede individual departmental mandates. Rather, each department will be expected to perform its statutory and regulatory responsibilities, or assume new or expanded roles in accordance with the relevant strategy provisions.

Municipal Mandate:

The Planning and Development Act, 1983 provides Saskatchewan municipalities with the authority to manage land use, development, municipal servicing and environmental issues within their respective jurisdictions. To this end, municipalities are empowered to adopt policy plans (development plans or basic planning statements), and corresponding zoning bylaws. The Act also provides for the establishment of provincial land use policies, which must be considered in the preparation and/or review of any plan or zoning bylaw. However, no such policies have been established to date.

The Great Sand Hills study area includes portions of three rural municipalities. The nature and degree of land use control exercised by each R.M. is documented below.

1. *R.M. of Clinworth No. 230*
   The R.M. of Clinworth adopted comprehensive basic planning statement (B.P.S.) and zoning bylaws in 1987. Beyond addressing

environmental management issues in general, these bylaws give special consideration to the Great Sand Hills.

In Part IV C of the B.P.S. (Non-Intensive Agricultural Development), the R.M. council is directed to cooperate with relevant federal and provincial agencies, "to carefully manage, preserve and develop the Great Sand Hills Area." With respect to the R.M. zoning bylaw, section 9 of part 3 provides for subdivision/development proposals to be referred to public and private agencies and consultants, and for public consultation beyond the minimum requirements as prescribed under the aforementioned Act.

Part 4D, section 24 of the zoning bylaw contains provisions relating specifically to petroleum, natural gas and mineral development. Such development is identified as a *permitted use* throughout the R.M.; that is, it shall be accommodated, but may be subject to development or environmental protection standards which council may establish in consultation with relevant agencies or professional/ technical consultants.

Part 7 of the zoning bylaw establishes the Agricultural Protection Zone, which roughly corresponds to the limits of the current study area, within the R.M. The stated purpose of this zone is "to accommodate developments, subdivisions and activities which:

(i) involve essentially non-intensive agricultural uses,

(ii) leave the land essentially in a natural state and,

(iii) do not require, or which minimize the necessity for mitigative, reclamation, rehabilitation and other environmental corrective measures."

The R.M. of Clinworth planning bylaws have proven to be an effective land use management tool, from the perspective of the R.M. council, and constitute a valuable, relevant model for use by other municipalities in the Great Sand Hills area.

2. *R.M. of Pittville No. 169*

The R.M. of Pittville has adopted an interim development control bylaw pursuant to *The Planning and Development Act*, which provides the R.M. council with discretionary control over land use and development in the municipality. This bylaw is intended as a temporary measure, for use until such time as the R.M. is able to adopt new planning bylaws. The time frame for bylaw preparation and adoption is uncertain.

3. *R.M. of Fox Valley No. 171*

The R.M. of Fox Valley does not have planning bylaws or any other form of local land use/development control, currently in place.

4. *Inter-Municipal Cooperation/Coordination*

At the September 1990 Great Sand Hills Land Use Plan public meetings, numerous groups and individuals expressed a strong desire for meaningful local input into decisions affecting land use and environmental management in the Great Sand Hills area. The planning committee supports this objective, subject to the development of a practical, effective means of coordinating the participation of the various public and private entities with interests or concerns in this regard.

One option for consideration involves the creation of an inter-municipal planning district, pursuant to Part IV of *The Planning and Development Act*. Section 120 of the Act provides for the establishment and spatial definition of advisory planning districts, which may consist of the whole or any part of two or more municipalities, based on such considerations as:

- topographic features;
- the extent of existing and probable development;
- the existence of important agricultural, resource, conservational, recreational or other problems;
- the existence of planning concerns common to the affiliated municipalities.

An agreement to establish a planning district must also provide for a district planning commission, to be composed of members appointed by each of the affiliated municipalities.

As part of its mandate, a commission is charged with the preparation of a district development plan, which must be adopted by each municipality. As well, the municipalities must adopt separate municipal zoning bylaws which conform to the district plan. It is noted that the development plan and zoning bylaws would apply only to those lands contained within the planning district.

Other duties that may be assigned to a district planning commission are advisory in nature, and are identified under Section 125 of the aforementioned Act.

The establishment of a planning district corresponding to the Great Sand Hills study area would provide a formal mechanism with which to pursue a coordinated and consistent approach to land use management, at the municipal level. Further, it

may constitute an appropriate vehicle for the consideration or accommodation of various local and regional interests.

Specific Recommendations:

1. The Great Sand Hills Land Use Strategy should be adopted as departmental policy, by those provincial agencies with identified interests and mandates in the study area. This would include a commitment to consultation and the coordinated management of land use and environmental concerns.

2. The establishment of a planning district or authority is recommended to provide a means of ensuring coordinated and consistent land use management at the municipal level, and to provide a mechanism for the consideration, accommodation and/or mediation of various public and private interests.

3. Rural Development should provide direction and assistance to the Rural Municipalities which administer land in the Great Sand Hills in establishing a local municipal development authority or district. The municipal authority or district should develop and implement local land use management plans and zoning bylaws that are consistent with the Great Sand Hills Land Use Strategy.

APPENDIX A

Great Sand Hills Recommended Seed Mix For Reclamation Purposes

Species	Recommended Variety	Alternative Variety
Hard Fescue	Durar	Covar Sheep Fescue
Canada Bluegrass	Reubans	Canon
Slender Wheatgrass	Revenue	None
Streambank Wheatgrass	Sodar	Walsh Western Wheatgrass
Northern Wheatgrass	Elbee	
Sainfoin (coated, inoculated)	Nova	Melrose
Alfalfa (coated, inoculated)	Heinrichs	Rangelander

APPENDIX B

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Appendix C

Great Sand Hills
Area Subject to Moratorium on New Land Uses
July 1990 to April 1991

Township / Range / W3M	Sections
T. 16, R. 22	N/2 8, N/2 9, N/2 10, N/2 11, 14, S/2 15, S/2 16, S/2 17, 18, 23 - 29, 32 - 36.
T. 17, R. 22	1 - 22, S/2 27, S/2 & NW 28, 29 - 34, N/2 & SW 35.
T. 18, R. 22	1 - 36.
T. 19, R. 22	1 - 10, 16 - 19.
T. 20, R. 22	7, 16 - 36.
T. 21, R. 22	1 - 6, S/2 8, S/2 9.
T. 16, R. 23	7, 8, 9, 13 - 18.
T. 17, R. 23	10 - 15, 22 - 28, 31 - 36.
T. 18, R. 23	1 - 6, 11 - 36.
T. 19, R. 23	1 - 24, 26 - 35.
T. 20, R. 23	2 - 14, 23 - 27, 34 - 36.
T. 21, R. 23	1.
T. 18, R. 24	1, 2, 13, 14, N/2 and SE 22, 23 - 27, 34 - 36.
T. 19, . 24	1, 11 - 15, 22 - 27, 34 - 36.
T. 20, R. 24	1 - 4, 8 - 12, 14 - 23.

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